

LEVEL

SUSQUEHANNA RIVER BASIN
MORRIS RUN, TIOGA COUNTY
PENNSYLVANIA

(1)

AD A108967

MORRIS RUN MINE DAM No. 3

NDI No. PA01027

PennDER No. 59-8

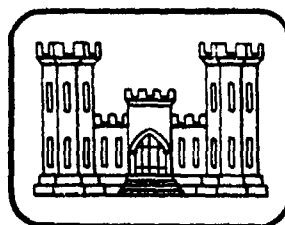
Dam Owner: Borough of Morris Run

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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

PACW31-81-C-0011



John A. Dziubek

prepared for

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

prepared by

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AUGUST 1981

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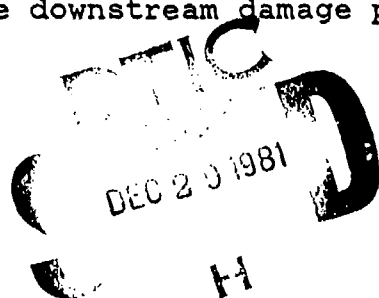
PREFACE

This report is prepared under guidance contained in the "Recommended Guidelines for Safety Inspection of Dams," for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.



Accession For	✓
WTIS GRA21	□
OTIC T18	□
Unannounced	□
Justification	□
By	for spec
Distribution	
Availability Codes	
and/or	
Special	

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
MORRIS RUN MINE DAM No. 3, TIOGA COUNTY, PENNSYLVANIA
NDI No. PA 01027, PennDER No. 59-8
MORRIS RUN
INSPECTED 31 MARCH 1981

ASSESSMENT OF
GENERAL CONDITIONS

✓
Morris Run Mine Dam No. 3 is owned by the Borough of Morris Run, Pennsylvania, and is classified as a "Significant" hazard - "Small" size dam. The dam was found to be in fair overall condition at the time of inspection.

Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District, Corps of Engineers, for Phase I Inspection Reports, revealed that the spillway will pass the 100-year flood without overtopping the dam. A spillway design flood (SDF) in the range of the 100-year flood to the 1/2 Probable Maximum Flood (1/2 PMF) is required for Morris Run Mine Dam No. 3. Since the dam is on the low end of the "Small" size category in terms of storage capacity, the 100-year flood was chosen as the SDF. The spillway capacity is greater than the inflow to the impoundment during the 100-year flood. The spillway is therefore considered "Adequate".

Several items of remedial work should be immediately initiated by the owner. These include:

- ✓
- 1) Protect the right abutment adjacent to the spillway with riprap or some other means of erosion protection.
 - 2) Provide for emergency upstream closures on the outlet pipes.
 - 3) Install a drain in the valve pit of the valve house.
 - 4) Repair the left spillway training wall where it is leaning into the spillway discharge channel.
 - 5) Cut all trees and brush on the embankment at ground level. All trees with a trunk diameter greater than 3 inches should have their root systems removed. All resultant areas of erosion and cavities should be filled, graded, compacted and seeded.

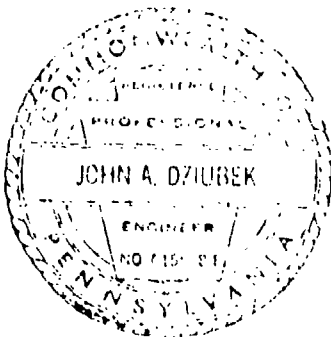
MORRIS RUN MINE DAM No. 3

- 6) As part of the general maintenance of the dam, the low area on the crest of the embankment adjacent to the left spillway training wall should be filled, compacted, and seeded to the average crest elevation.

In addition, the following operational measures are recommended to be undertaken by the owner:

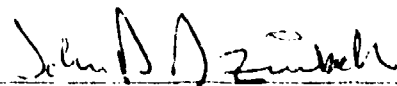
- 1) Develop a detailed emergency operation and warning system.
- 2) During periods of unusually heavy rainfall, provide around-the-clock surveillance of the dam.
- 3) When warning of a storm of major proportions is given by the National Weather Service, activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operational procedures and records be developed and implemented. These should be included in a formal maintenance and operations manual for the dam. As a part of the formal inspection, the two wet areas near the left abutment and seep near the gatehouse should be observed and the condition recorded.



Submitted by:

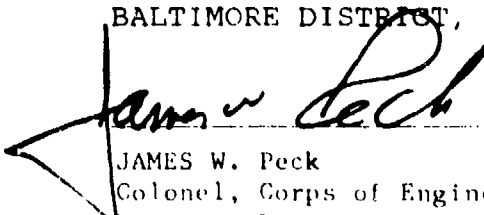
MICHAEL BAKER, JR., INC.


John A. Dziubek, P.E.
Engineering Manager-Geotechnical

Date: 20 August 1981

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS


JAMES W. Peck
Colonel, Corps of Engineers
District Engineer

Date: 31 Aug 81

MORRIS RUN MINE DAM NO. 3



Overall View of Dam from Right Abutment

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
MORRIS RUN MINE DAM No. 3
NDI No. PA 01027, PennDER No. 59-8

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. Authority - The Dam Inspection Act, Public Law 92-367, authorized by the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.
- b. Purpose of Inspection - The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dam and Appurtenances - Morris Run Mine Dam No. 3 is an earthfill embankment 332 feet long and 25.1 feet high. The embankment has a crest width of 8.5 feet and side slopes of 2.1H:1V (Horizontal to Vertical) upstream and 2.4H:1V downstream. The upstream face of the embankment is protected with riprap.

The spillway, at the right abutment, is a concrete broad-crested weir 88.8 feet long perpendicular to the direction of flow. The spillway has a freeboard of 4.5 feet. The discharge channel consists of a concrete rectangular channel approximately 105 feet long with concrete energy dissipators at the downstream end. Flows from the discharge channel fall approximately 9 feet to the rock lined downstream channel.

The outlet works consist of a 10-inch cast iron pipe and a 12-inch cast iron pipe. The pipes extend from the reservoir to the gatehouse on the downstream side of the dam. Gate valves in the gatehouse control the outlets. A 12-inch clay tile outlet pipe discharges from the gatehouse to the downstream channel. The 10-inch pipe serves as a water supply line. The 12-inch pipe serves as a blow-off line.

- b. Location - Morris Run Mine Dam No. 3 is located on Morris Run in Hamilton Township, Tioga County, Pennsylvania. The dam is approximately 0.75 mile north of Morris Run in Hamilton Township. The coordinates of the dam are N 41° 41.4' and W 77° 00.9'. The dam can be found on the USGS 7.5 minute topographic quadrangle, Blossburg, Pennsylvania.
- c. Size Classification - The height of the dam is 25.1 feet. Storage at the top of the dam [elevation 1776.5 feet Mean Sea Level (ft. M.S.L.)] is 87 acre-feet. The dam is therefore in the "Small" size category.
- d. Hazard Classification - If the dam should fail, economic damage is likely to two homes located downstream of the dam, 3400 feet and 3700 feet. These homes range from 5 feet to 10 feet above the streambed. Approximately 1500 feet downstream is a shed used for the storage of explosives; this shed is on the bank of the stream. Loss of life may occur; therefore, the dam is in the "Significant" hazard category.
- e. Ownership - The dam is owned by the Borough of Morris Run, Pennsylvania 16939.
- f. Purpose of Dam - The impoundment created by the dam is used for water supply.
- g. Design and Construction History - Morris Run Mine Dam No. 3 was designed by John H. Lance, Consulting Engineer of Wilkes-Barre, Pennsylvania. Construction of the dam began in November 1919 and was completed in the fall of 1920. In 1975, the discharge channel was repaired after having been damaged by Tropical Storm Agnes in 1972.
- h. Normal Operating Procedures - The reservoir is typically maintained at the spillway crest, elevation 1772.0 feet M.S.L.

1.3 PERTINENT DATA

- a. Drainage Area (square miles) - 3.40
- b. Discharge at Dam Site (c.f.s.) -
 - Maximum Flood - (1975) - 550.0
 - Spillway Capacity at Maximum Pool
(El. 1776.5 ft. M.S.L.) 2740.0

c. Elevation* (feet above Mean Sea Level [ft. M.S.L.]) -

Design Top of Dam -	1777.5
Minimum Top of Dam -	1776.5
Maximum Design Pool -	Unknown
Spillway Crest -	1772.0
Streambed at Toe of Dam -	1751.4
Maximum Tailwater of Record -	Unknown

d. Reservoir (feet) -

Length of Maximum Pool (El. 1776.5 ft. M.S.L.) -	1800.0
Length of Normal Pool (El. 1772.0 ft. M.S.L.) -	800.0

e. Storage (acre-feet) -

Top of Dam (El. 1776.5 ft. M.S.L.) -	87.0
Normal Pool (El. 1772.0 ft. M.S.L.) -	38.0

f. Reservoir Surface (acres) -

Top of Dam (El. 1776.5 ft. M.S.L.) -	9.9
Normal Pool (El. 1772.0 ft. M.S.L.) -	5.0

g. Dam -

Type -	Earthfill
Total Length (feet) -	332.0
Height (feet) - Design -	20.5
Field -	25.1
Top Width (feet) -	8.5
Side Slopes - Upstream - Design -	2H:1V
Field -	2.1H:1V
Downstream - Design -	2H:1V
Field -	2.4H:1V
Zoning -	None
Impervious Core -	None
Cutoff -	Clay Puddle
Drains -	8" Spillway Drain

*All elevations are referenced to the spillway crest, Elevation 1772.0 feet M.S.L., as estimated from the USGS 7.5 minute topographic quadrangle, Blossburg, Pennsylvania.

h. Diversion and Regulating Tunnels - None

i. Spillway -

Type - Broad-crested weir

Location - Right abutment

Length of Crest Perpendicular to

Flow (feet) -

88.8

Crest Elevation (ft. M.S.L) -

1772.0

Gates -

None

Downstream Channel - Rectangular concrete discharge channel, into trapezoidal rock lined channel.

j. Outlet Works - The outlet works consists of a 10-inch water supply line and a 12-inch blow-off line. The submerged inlet on the upstream side of the dam is encased in concrete. The entire length of the water supply and blow-off pipes are encased in concrete. Valves are in the gatehouse at the downstream toe of the dam. The 12-inch blow-off discharges to the downstream channel.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Information reviewed for preparation of this report consisted of the Pennsylvania Department of Environmental Resources' (PennDER) File No. 59-8A. This included:

- 1) The permit application to the Water Supply Commission of Pennsylvania, from Morris Run Coal Mining Company, to construct a reservoir (dated 16 July 1919).
- 2) Location map, general map, plan and profile and detail plans of the dam and reservoir as proposed by John H. Lance, Consulting Engineer. The reference datum for the drawings is unknown.
- 3) The permit issued by The Water Supply Commission, allowing construction of the dam (dated 17 July 1919).
- 4) Progress reports on the construction of the dam prepared by The Water Supply Commission (dated 30 November 1919 through 2 June 1921).
- 5) Several inspection reports on the condition of the dam indicating gradual deterioration of the spillway wingwalls and brush growing on the dam (dated 1 June 1924 through 30 September 1965).
- 6) A Damage Survey Report, from the Office of Emergency Preparedness, reporting damage to the spillway (dated 26 July 1972).
- 7) The permit issued by the Water and Power Resources Board to the supervisors of Hamilton Township for repair of the dam (dated 23 September 1974).
- 8) Correspondence indicating the repairs to the spillway were completed on 1 October 1975.

2.2 CONSTRUCTION

The dam was constructed in 1919 and 1920. The spillway discharge channel was rebuilt in 1975.

2.3 OPERATION

No formal procedures are followed for operation of the dam and reservoir. The spillway is uncontrolled and the reservoir is typically at the spillway crest level.

2.4 EVALUATION

- a. Availability - The information reviewed is readily available from PennDER File No. 59-8A.
- b. Adequacy - The information available combined with the visual inspection measurements and observations is adequate for a Phase I Inspection of this dam.
- c. Validity - Several items were noted that do not correspond with the available plans. The following items are the changes noted:
 - 1) A 12-inch blow-off pipe was installed instead of the 14-inch pipe shown on the design plans.
 - 2) The blow-off pipe has been extended to the downstream channel using a 12-inch clay pipe.
 - 3) The spillway has been modified.
 - 4) The downstream reservoir has been filled in.
 - 5) Gabions have been placed along the right spillway training wall at the transition into the reconstructed section of the spillway.
 - 6) A stone gatehouse is at the downstream toe of the embankment instead of an underground box.
 - 7) The crest elevation was lowered 1 foot at the time of construction.

Other than the above mentioned items, there is no reason at the present time to doubt the validity of the available engineering data.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General - The inspection was performed on 31 March 1981. It was sunny with temperatures in the low 70's at the time of inspection. Noteworthy deficiencies observed during the visual inspection are described in the following paragraphs. The complete visual inspection check list, field sketch, top of dam profile and typical cross section are presented in Appendix A.
- b. Dam - A low area (0.5 foot) is located immediately to the left of the spillway. The embankment is covered with small trees and brush. A minor clear seep (0.5 g.p.m.) was flowing from the gate house. Two wet areas were observed below the toe of the embankment near the left abutment. The right spillway training wall has collapsed into the spillway, exposing the right abutment to erosion.
- c. Appurtenant Structures - The right wall of the discharge channel (about 100 feet) has fallen into the channel. The valve house is in good condition; however, the valve pit in the valve house was full of water at the time of inspection. The left spillway training wall leans into the spillway channel approximately 1 foot at the top.

The intake structure was submerged during the inspection. No upstream closure is provided for the outlet pipes which pass through the embankment.
- d. Reservoir Area - The reservoir side slopes are fairly steep and wooded. No signs of instability were observed. Sedimentation is not reported to be a problem.
- e. Downstream Channel - The downstream channel has mild slopes through a narrow valley. The stream passes under the road twice through 8 foot diameter culverts. Two homes are located 3400 feet and 3700 feet downstream from the dam. Economic damage is likely to these homes in the event of failure of the dam. Approximately 1500 feet downstream is a shed used for the storage of explosives; this shed is on the bank of the stream.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no formal procedures for operating the reservoir or evacuating the downstream area in case of an emergency. It is recommended that formal emergency procedures be adopted, prominently displayed and furnished to all operating personnel.

4.2 MAINTENANCE OF DAM

There are no formal records of maintenance or formal procedures for evaluating the necessity of maintenance for the structure. It is recommended that formal inspection procedures be developed.

4.3 MAINTENANCE OF OPERATING FACILITIES

Maintenance is unscheduled. It is recommended that a formal operation and preventive maintenance schedule be developed and implemented.

4.4 DESCRIPTION OF WARNING SYSTEM

There is no warning system to be implemented in the event of dam failure. It is recommended that an emergency warning system be developed.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The current operational features are adequate for the purpose they serve. However, it is recommended that a formal maintenance and operations manual be prepared for the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data - No hydrologic or hydraulic design calculations are available for Morris Run Mine Dam No. 3.
- b. Experience Data - A maximum discharge of 550 c.f.s. was reported by Steward Milnes, P.E., of Milnes Engineering, Inc., during a storm in 1975.
- c. Visual Observations - During the visual inspection, no problems were observed which would indicate that the dam and appurtenant facilities could not perform satisfactorily during a flood event.

The right spillway training wall has collapsed, exposing natural ground at the right abutment to erosion from high storm flows.

- d. Overtopping Potential - Morris Run Mine Dam No. 3 is a "Small" size - "Significant" hazard dam requiring evaluation for a spillway design flood (SDF) in the range of the 100-year flood to the 1/2 Probable Maximum Flood (1/2 PMF). Because the dam is on the low end of the "Small" size category in terms of storage capacity, the 100-year flood was chosen as the SDF.

Using material from "The Hydrologic Study - Tropical Storm Agnes" prepared by the Corps of Engineers, New York District, the peak inflow to the impoundment for the 100-year flood was calculated to be 2780 c.f.s. The peak inflow to the impoundment for the 100-year flood was also calculated to be 1400 c.f.s., using material from "Water Resources Bulletin, Bulletin No. 13, Floods in Pennsylvania", prepared by the Department of Environmental Resources, Commonwealth of Pennsylvania. Averaging these two methods produced a peak inflow of 2090 c.f.s., which was used in this analysis.

The spillway capacity at the minimum top of the dam is 2740 c.f.s, which is greater than the inflow of 2090 c.f.s. to the impoundment.

- e. Spillway Adequacy - As outlined in the above analysis, the spillway capacity is greater than the inflow to the impoundment during the 100-year storm; therefore, the spillway is considered "Adequate".

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observations - The two wet areas near the left abutment and the seep from the gate house should be observed during future inspections. The brush and small trees on the embankment will cause problems in the future if allowed to remain.
- b. Design and Construction Data - Calculations of slope and structural stability were not available for review. The slopes have had a history of satisfactory performance. In view of the modest height of the dam, a history of satisfactory performance of its moderate slopes, and no signs of distress observed during the visual inspection, no further stability analysis is deemed necessary.
- c. Operating Records - Nothing in the procedures described by the owner's representative indicates concern relative to the structural stability of the dam.
- d. Post-Construction Changes - No changes adversely affecting the structural stability of the dam have been performed.
- e. Seismic Stability - The dam is located in Seismic Zone 1 of the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams". This is a zone of minor seismic activity. Therefore, further consideration of the seismic stability is not warranted since the dam is considered to be structurally stable.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

- a. Safety - Morris Run Mine Dam No. 3 was found to be in fair overall condition at the time of inspection. Morris Run Mine Dam No. 3 is a "Significant" hazard - "Small" size dam requiring a spillway capacity in the range of the 100-year flood to the 1/2 PMF. The 100-year flood was chosen as the SDF because the dam is on the low side of the "Small" size category based on storage capacity. As presented in Section 5, the spillway capacity is greater than the peak inflow to the impoundment for the 100-year flood. Therefore, the spillway is considered "Adequate".

The two wet areas near the left abutment and seep from the gate house should be monitored during future inspections for turbidity and/or an increase in flow.

- b. Adequacy of Information - The information available and the observations and measurements made during the field inspection are considered sufficient for this Phase I Inspection Report.
- c. Urgency - The owner should initiate the action discussed in paragraph 7.2 as soon as practicable.
- d. Necessity for Additional Data/Evaluation - No further investigation is deemed necessary.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection revealed certain items of remedial work which should be performed by the owner without delay. These include:

- 1) Protect the right abutment adjacent to the spillway with riprap or some other means of erosion protection.
- 2) Provide for emergency upstream closures on the outlet pipes.
- 3) Install a drain in the valve pit of the valve house.

- 4) Repair the left spillway training wall where it is leaning into the spillway discharge channel.
- 5) Cut all trees and brush on the embankment at ground level. All trees with a trunk diameter greater than 3 inches should have their root systems removed. All resultant areas of erosion and cavities should be filled, graded, compacted and seeded.
- 6) As part of the general maintenance of the dam, the low area on the crest of the embankment adjacent to the left spillway training wall should be filled, compacted, and seeded to the average crest elevation.

In addition, the following operational measures are recommended to be undertaken by the owner:

- 1) Develop a detailed emergency operation and warning system.
- 2) During periods of unusually heavy rainfall, provide around-the-clock surveillance of the dam.
- 3) When warning of a storm of major proportions is given by the National Weather Service, activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operational procedures and records be developed and implemented. These should be included in a formal maintenance and operations manual for the dam. As a part of the formal inspection, the two wet areas near the left abutment and seep from the gate house should be observed and the condition recorded.

APPENDIX A

VISUAL INSPECTION CHECK LIST, FIELD SKETCH.
TOP OF DAM PROFILE, AND TYPICAL CROSS-SECTION

Check List
Visual Inspection
Phase 1

Name of Dam Morris Run Mine Dam No. 3 County Tioga State Pennsylvania Coordinates Lat. N 41°41.4'
 NDI #PA 01027 Long. W 77°00.9'
 Pennder #59-8
 Date of Inspection 31 March 1981 Weather sunny Temperature 70°

Pool Elevation at Time of Inspection 1772.0 ft.* M.S.L. Tailwater at Time of Inspection 1751.4 ft. M.S.L.
 *All elevations are referenced to the spillway crest, El. 1772.0 ft. M.S.L. as estimated from the USGS 7.5 minute topographic quadrangle, Blossburg, Pennsylvania.

Inspection Personnel:

Michael Baker, Jr., Inc.:

James G. Uliniski
 Jeff L. Sawyer
 Gary W. Todd

Owner's Representatives:

Mervin Harbold - Supr. for
 Borough of Morris Run
 John Stenpeck - Supr. for
 Borough of Morris Run

James G. Uliniski Recorder

A-2

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: MORRIS RUN MINE DAM NO. 3

NDI #PA 01027

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
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LEAKAGE

STRUCTURE TO
ABUTMENT/EMBANKMENT
JUNCTIONS

DRAINS

WATER PASSAGES

FOUNDATION

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: MORRIS RUN MINE DAM NO. 3
NDI #PA 01027

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES		
STRUCTURAL CRACKING		
VERTICAL AND HORIZONTAL ALIGNMENT		
MONOLITH JOINTS		
CONSTRUCTION JOINTS		

EMBANKMENT

Name of Dam MORRIS RUN MINE DAM NO. 3

NDI #PA 01027

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
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SURFACE CRACKS

None observed.

UNUSUAL MOVEMENT OR
CRACKING AT OR BEYOND
THE TOE

None observed.

SLOUGHING OR EROSION OF
EMBANKMENT AND ABUTMENT
SLOPES

None observed.

EMBANKMENT

Name of Dam MORRIS RUN MINE DAM NO. 3

NDI #PA 01027

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good horizontal alignment, the crest is 0.5 ft. low near the left training wall.	Fill low area of crest and reseed.
RIPRAP FAILURES	None observed.	
VEGETATION	Small trees and brush are growing on the embankment.	Cut the trees and brush on the embankment and for 10 ft. beyond the toe.

EMBANKMENT

Name of Dam MORRIS RUN MINE DAM NO. 3

NDI #PA 01027

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	The right spillway training wall has collapsed into the spillway exposing the right abutment to erosion.	Protect the abutment with riprap or some type of erosion protection.
ANY NOTICEABLE SEEPAGE	Two wet areas were observed below the toe of the dam near the left abutment. A minor seep (0.5 g.p.m.) was observed at the gatehouse.	Monitor the wet areas and seep to determine if turbid- ity and/or increased flows occur. Installation of a drain from the gatehouse may eliminate the seep.

STAFF GAGE AND RECORDER

None

DRAINS

None

OUTLET WORKS

Name of Dam: MORRIS RUN MINE DAM NO. 3

NDI #PA 01027

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

CRACKING AND SPALLING OF None observed.

CONCRETE SURFACES IN
OUTLET CONDUIT

INTAKE STRUCTURE

The intake structure was submerged at the time of inspection. No upstream closure was provided for the 12" or 10" intake pipes.

Provide upstream closure for the intake pipes.

OUTLET STRUCTURE

A stone masonry valve house located on the downstream toe of the dam contains the control valves for the 10" water supply line and 12" blow-off line. The valve pit in the valve house was full of water.

The valve house is in good condition. Provide a drain for the valve pit.

OUTLET CHANNEL

Natural stream channel is in good condition.

EMERGENCY GATE

None observed.

UNGATED SPILLWAY

Name of Dam: MORRIS RUN MINE DAM NO. 3

NDI #PA 01027

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
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CONCRETE WEIR

Concrete weir is in good condition.

APPROACH CHANNEL

Concrete approach apron appears in good condition. The left training wall leans toward the spillway approximately 1 ft. at the top. Right training wall has collapsed into the spillway.

Protect the right slope of the spillway with riprap or some other type of erosion protection.

DISCHARGE CHANNEL

Concrete discharge channel is in good condition. The right training wall has fallen into the spillway for about 100 ft. The discharge channel has concrete energy dissipators at the downstream end.

Provide slope protection for the right abutment.

BRIDGE AND PIERS

None.

A-0

GATED SPILLWAY N/A

Name of Dam: MORRIS RUN MINE DAM NO. 3

NDI #PA 01027

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

CONCRETE SILL

APPROACH CHANNEL

DISCHARGE CHANNEL

BRIDGE AND PIERS

GATES AND OPERATION
EQUIPMENT

INSTRUMENTATION

Name of Dam: MORRIS RUN MINE DAM NO. 3

NDI #PA 01027

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION

MONUMENTATION/SURVEYS

None observed.

OBSERVATION WELLS

None observed.

WEIRS

None observed.

PIEZOMETERS

None observed.

OTHER

None observed.

RESERVOIR

Name of Dam: MORRIS RUN MINE DAM NO. 3

NDI #PA 01027

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

SLOPES

The reservoir side slopes are fairly steep (15° - 30°), but no signs of instability were observed.

SEDIMENTATION

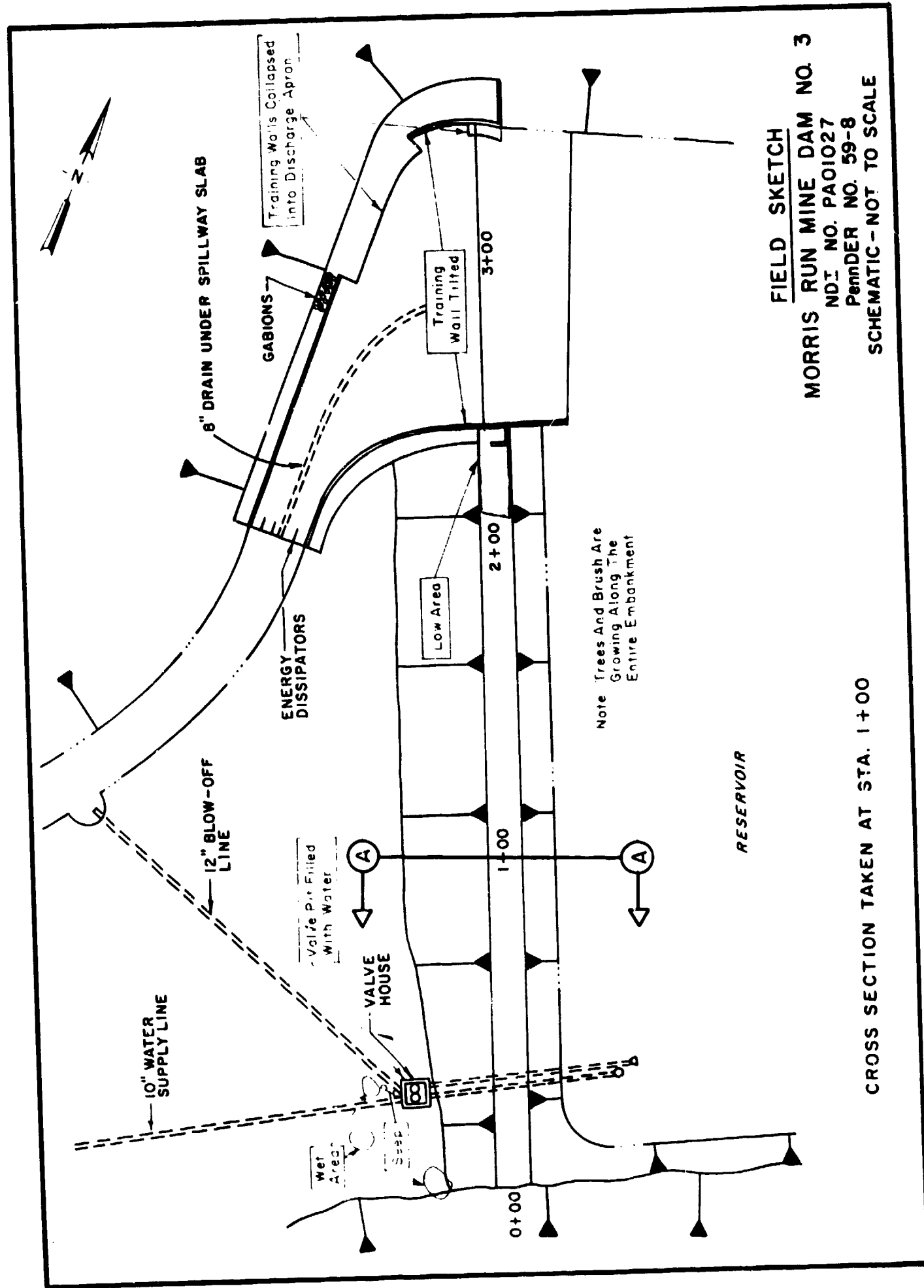
Sedimentation is not reported to be a problem.

DOWNSTREAM CHANNEL

Name of Dam: MORRIS RUN MINE DAM NO. 3

NDI #PA 01027

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No debris was present in the channel. The stream crossed the road several times through 8 ft. diameter culverts.	
SLOPES	The downstream channel has mild slopes through a narrow valley.	
APPROXIMATE NO. OF HOMES AND POPULATION	Two homes are located 3400 ft. and 3700 ft. downstream from the dam. A shed used for storing explosives is located downstream from the dam.	Economic damage is likely to both homes in the event of failure of the dam. Loss of life may occur.



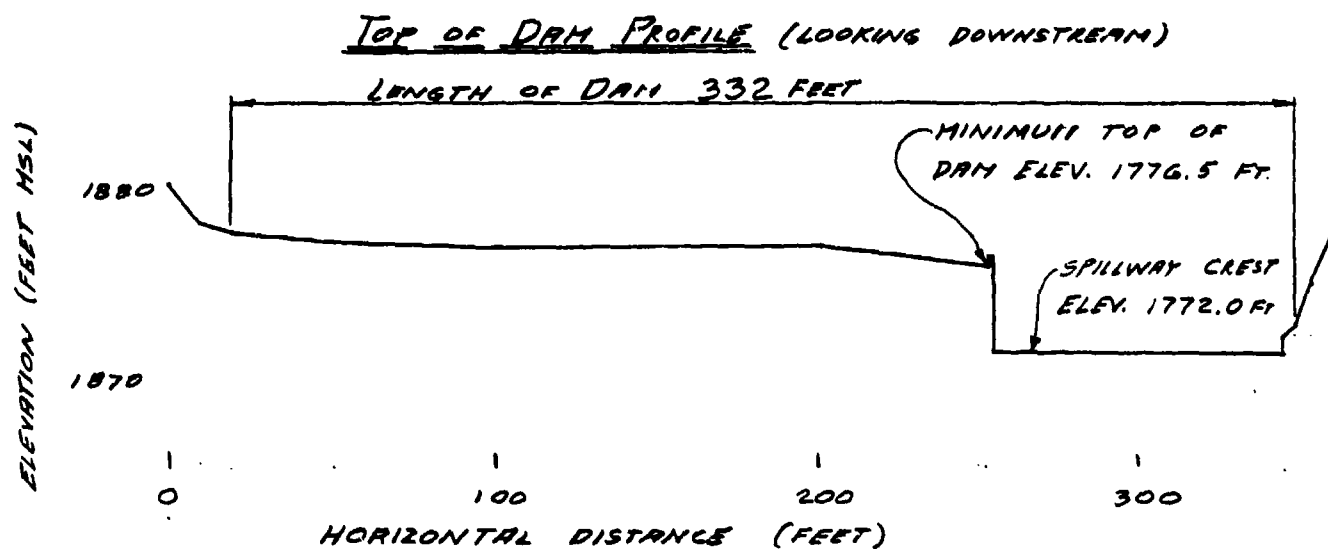
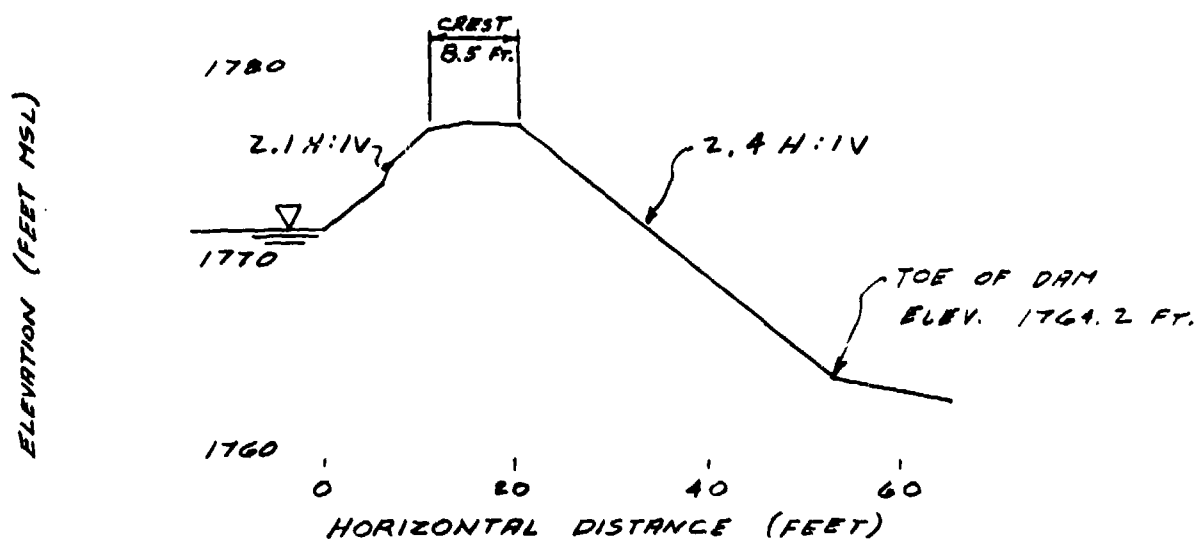
MICHAEL BAKER, JR., INC.

MORRIS RUN MINE DAM No. 3

THE BAKER ENGINEERS

TOP OF DAM PROFILE
TYPICAL CROSS-SECTIONBox 280
Beaver, Pa. 15009

DATE OF INSPECTION: 31 March 1981

TYPICAL CROSS SECTION AT STATION 1+00

APPENDIX B
ENGINEERING DATA CHECK LIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: Morris Run Mine Dam No. 3
NDI #PA 01027

ITEM	REMARKS
PLAN OF DAM	See Plate 6 of this report.
REGIONAL VICINITY MAP	A USGS 7.5 minute topographic quadrangle, Blossburg, Pennsylvania, was used to prepare the vicinity map which is enclosed in this report as the Location Plan (Plate 1).
CONSTRUCTION HISTORY	The dam was designed by John W. Lance, Consulting Engineer. The dam was constructed between November 1919, and the Fall of 1920. The spillway and discharge channel were rebuilt in 1975.
TYPICAL SECTIONS OF DAM	See Plate 7 of this report.
HYDROLOGIC/HYDRAULIC DATA	No information available.
OUTLETS - PLAN	See Plate 7 of this report.
- DETAILS	None
- CONSTRAINTS	None
- DISCHARGE RATINGS	No information available.
RAINFALL/RESERVOIR RECORDS	No records are maintained.

Name of Dam: MORRIS RUN MINE DAM NO. 3

NDI #PA 01027

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	No geology reports are available for the dam. See Appendix P for the Regional Geology.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES	No information available.

Name of Dam: MORRIS RUN MINE DAM NO. 3

NDI #PA 01027

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	During initial construction, the spillway crest and embankment were each raised one ft. higher than indicated on the plans. In 1975, the spillway discharge channel was modified during the reconstruction. See Section 2.4 for additional modifications.
HIGH POOL RECORDS	A maximum discharge of 550 C.F.S. was reported by Stewart Milnes, P.E., of Milnes Engineering, Inc., during the Eloise Storm in 1975.
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Study was conducted in 1973-74 by Milnes Engineering, Inc., to rebuild the discharge channel.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	During the tropical storm Agnes in 1972, the lower portion of the spillway discharge channel was washed out.
MAINTENANCE OPERATION RECORDS	No formal records of maintenance and operation are maintained.

Name of Dam: MORRIS RUN MINE DAM NO. 3
NDI #PA 01027

B-4

ITEM

REMARKS

SPILLWAY PLAN,

See Plates 6 and 7 of this report.

SECTIONS,
and
DETAILS

OPERATING EQUIPMENT
PLANS & DETAILS

No plans available.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 3.41 sq. mi. (primarily forested)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1772.0 ft. M.S.L.

(38 Ac.-Ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1776.5 ft. M.S.L.

(87 Ac.-Ft.)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1776.5 ft. M.S.L. (Minimum top of dam)

SPILLWAY:

- a. Crest Elevation 1772.0 ft.
- b. Type Rectangular concrete channel
- c. Width of Crest Parallel to Flow Triangular weir
- d. Length of Crest Perpendicular to Flow 88.8 ft.
- e. Location Spillover Right abutment
- f. Number and Type of Gates None

OUTLET WORKS: 10" water supply line and 12" blow-off

- a. Type _____
- b. Location Near left abutment
- c. Entrance Inverts Unknown
- d. Exit Inverts 1753.0 ft. for blow-off
- e. Emergency Drawdown Facilities 12" blow-off to downstream channel

HYDROMETEOROLOGICAL GAGES: None

- a. Type _____
- b. Location _____
- c. Records _____

MAXIMUM NON-DAMAGING DISCHARGE 550 C.F.S.

APPENDIX C
PHOTOGRAPH LOCATION PLAN AND PHOTOGRAPHS

Detailed Photograph Descriptions

Overall View of Dam - Overall View From Right Abutment

Photograph Location Plan

Photo 1 - View of Upstream Slope From Left Abutment

Photo 2 - View of Crest of Dam From Left Abutment

Photo 3 - View of Downstream Slope From Left Side of Spillway

Photo 4 - View of Spillway Crest From Left Training Wall

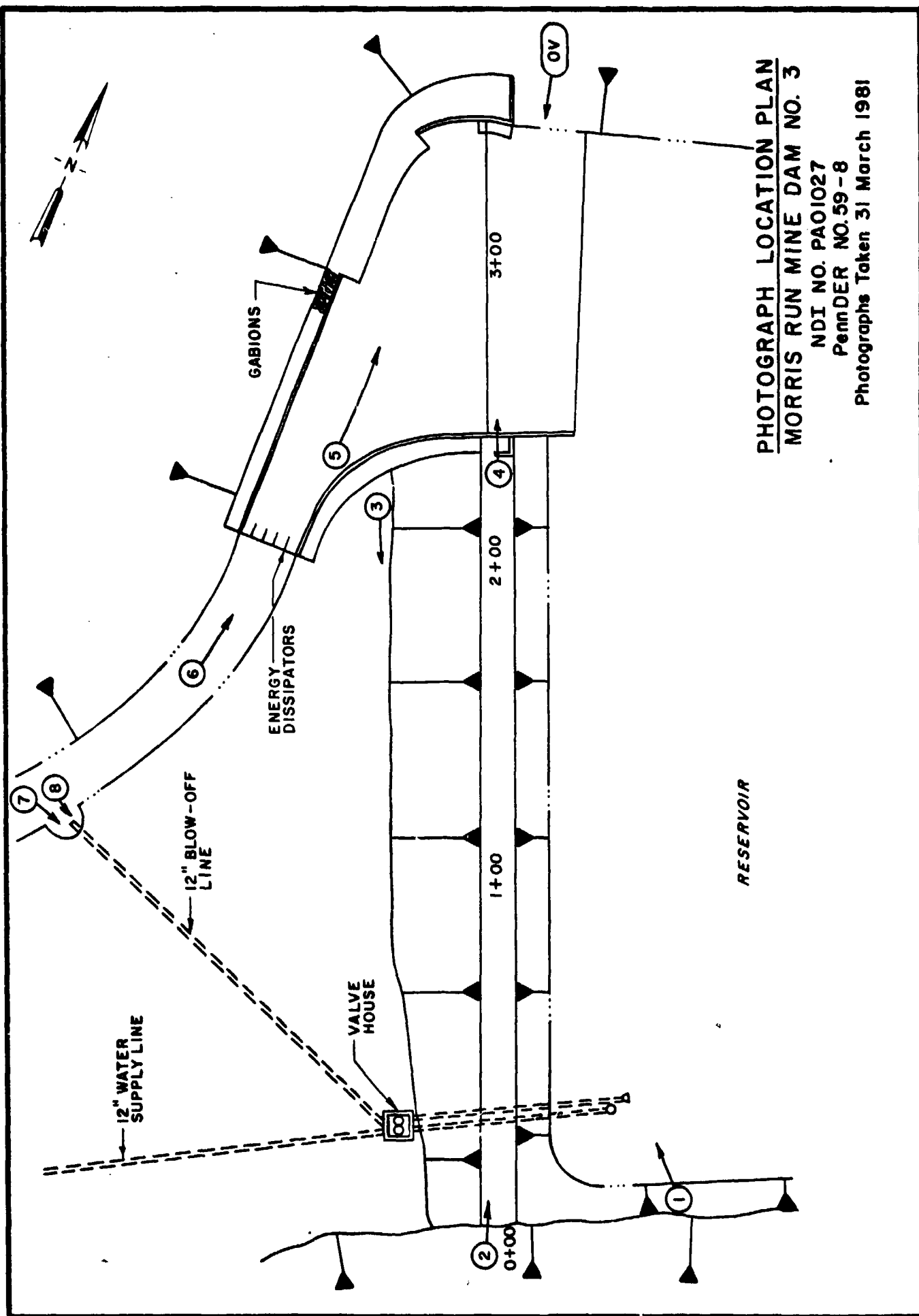
Photo 5 - View of Spillway Crest From Right Training Wall

Photo 6 - View of Spillway Discharge and Energy Dissipator

Photo 7 - View of Valve House and Outlet Pipe

Photo 8 - View of Discharge End of Outlet Pipe

Note: Photographs were taken on 31 March 1981.



PHOTOGRAPH LOCATION PLAN
MORRIS RUN MINE DAM NO. 3

NDI NO. PA01027

PennDER NO.59-8

Photographs Taken 31 March 1981

MORRIS RUN MINE DAM NO. 3



PHOTO 1. View of Upstream Slope From Left Abutment

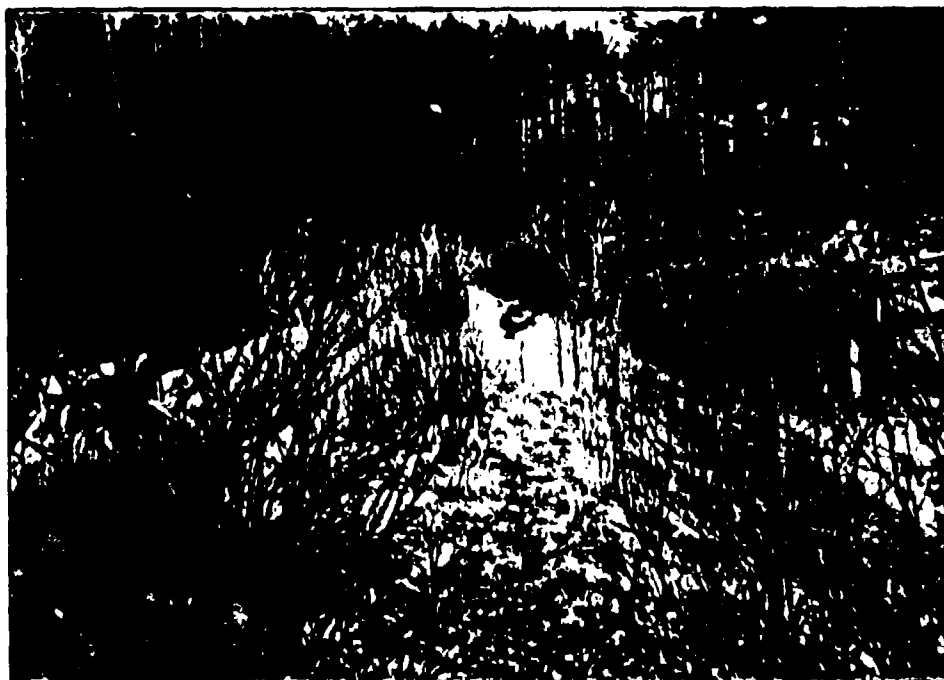


PHOTO 2. View of Crest of Dam From Left Abutment

MORRIS RUN MINE DAM NO. 3



PHOTO 3. View of Downstream Slope From Left Side of Spillway



PHOTO 4. View of Spillway Crest From Left Training Wall

MORRIS RUN MINE DAM NO. 3



PHOTO 5. View of Spillway Right Training Wall



PHOTO 6. View of Spillway Discharge and Energy Dissipater

MORRIS RUN MINE DAM NO. 3

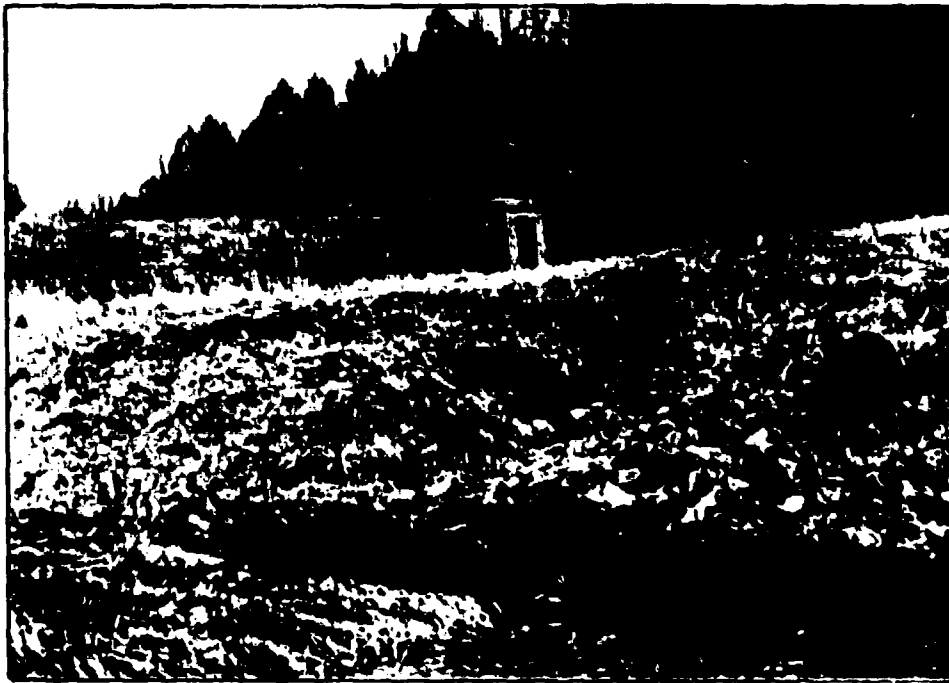


PHOTO 7. View of Valve House and Outlet Pipe

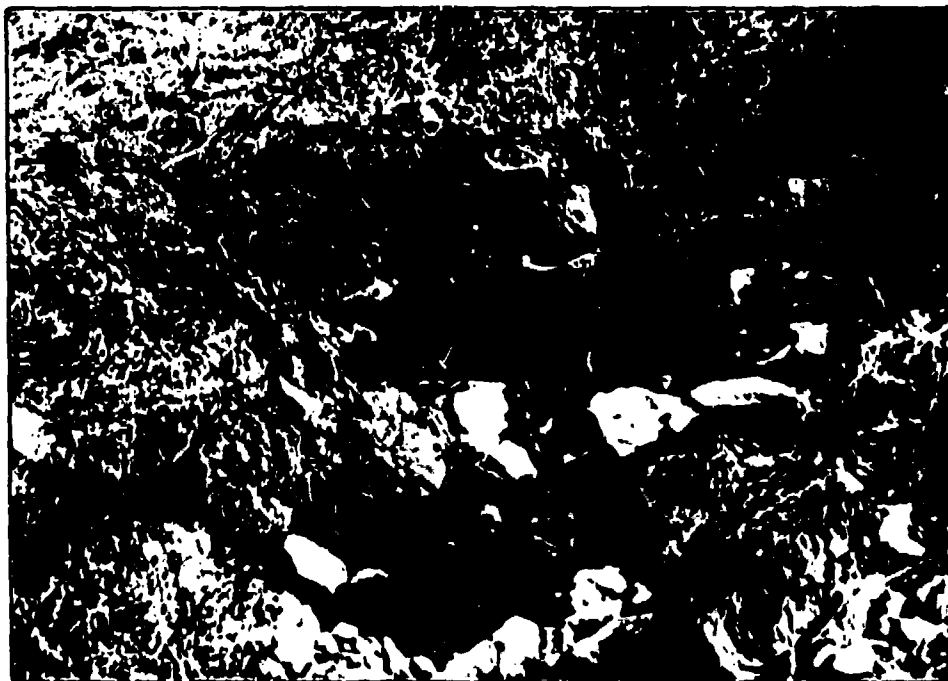


PHOTO 8. View of Discharge End of Outlet Pipe

APPENDIX D
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MICHAEL BAKER, JR., INC.

THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject MORRIS RUN MINE DAM No. 3 S.O. No. _____
APPENDIX D - HYDROLOGIC AND Sheet No. _____ of _____
HYDRAULIC CALCULATIONS Drawing No. _____
Computed by _____ Checked by _____ Date _____

<u>SUBJECT</u>	<u>PAGE</u>
PREFACE	i
HYDRAULIC DATA	1
DRAINAGE AREA AND CENTROID MAP	2
TOP OF DAM PROFILE AND CROSS SECTION	3
SPILLWAY DISCHARGE RATING	4
20-YEAR DISCHARGE CALCULATION	6

PREFACE

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Conclusions presented herein pertain to present conditions. The effect of future development on the hydrology of the watershed has not been considered.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject B. Dam Inspections S.O. No. _____
Morris Run Mine Dam No. 3 Sheet No. 1 of 7
HYDRAULIC DATA Drawing No. _____
Computed by GBD Checked by EWI Date 4/7/81

DRAINAGE AREA

GLEASON QUAD. 1542.51
BLOSSBURG QUAD. 5002.50 } $\frac{6545.01}{3} = 2181.67 \text{ Acres} = 3.41 \text{ Sq. Mi.}$

SURFACE AREAS

LAKE SURFACE @ El. 1772 - $\frac{15.12}{3} = 5.04 \text{ Acres}$
El. 1780 - $\frac{100.53}{3} = 33.51 \text{ Acres}$
El. 1800 - $\frac{258.90}{3} = 86.30 \text{ Acres}$

WATERSHED LENGTHS

L = 18,400 Ft. = 3.48 mi.
Lc = 8,650 Ft. = 1.64 mi.

NORMAL POOL STORAGE

$$\text{STORAGE VOLUME} = V = \frac{h}{3} (A_1 + A_2 + \sqrt{A_1 A_2})$$

A₁ = BOTTOM AREA

A₂ = SURFACE AREA OF POOL

h = HEIGHT

$$V = \frac{8}{3} (4.4 + 5.04 + \sqrt{(4.4)(5.04)})$$

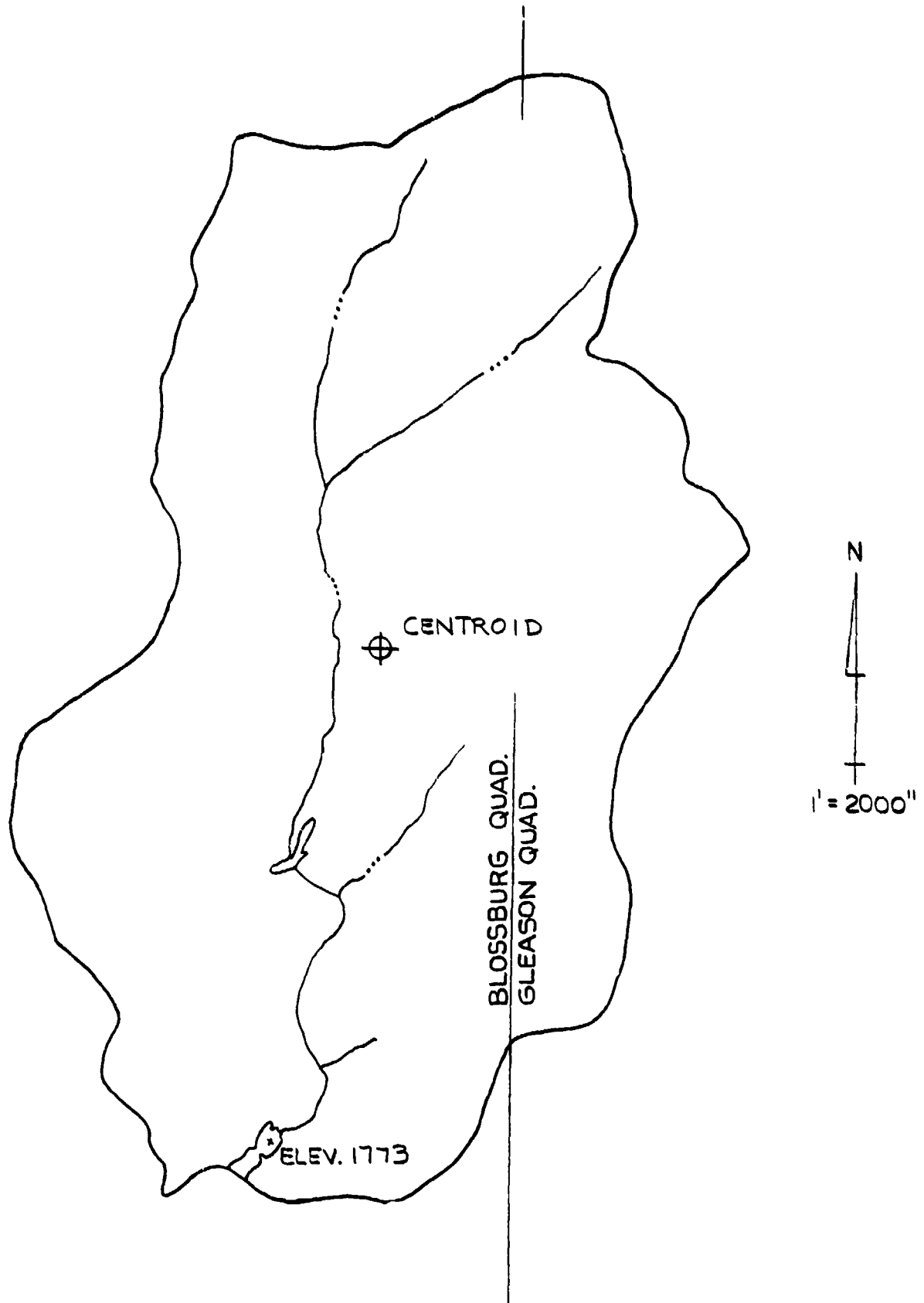
$$V = 38 \text{ AC-FT}$$

TOP OF DAM STORAGE

$$\text{STORAGE VOLUME} = V = \frac{h}{3} (A_1 + A_2 + \sqrt{A_1 A_2})$$

$$= \frac{12.5}{3} (4.4 + 9.9 + \sqrt{(4.4)(9.9)})$$

$$V = 87 \text{ AC-FT}$$

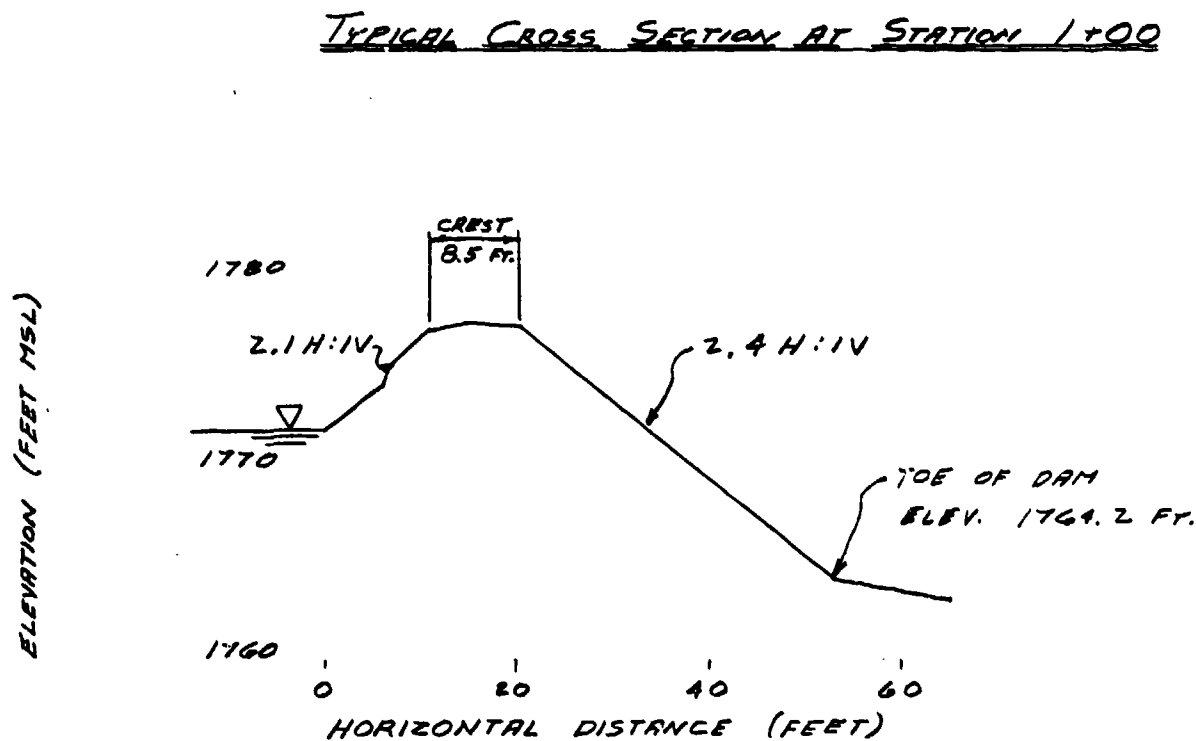
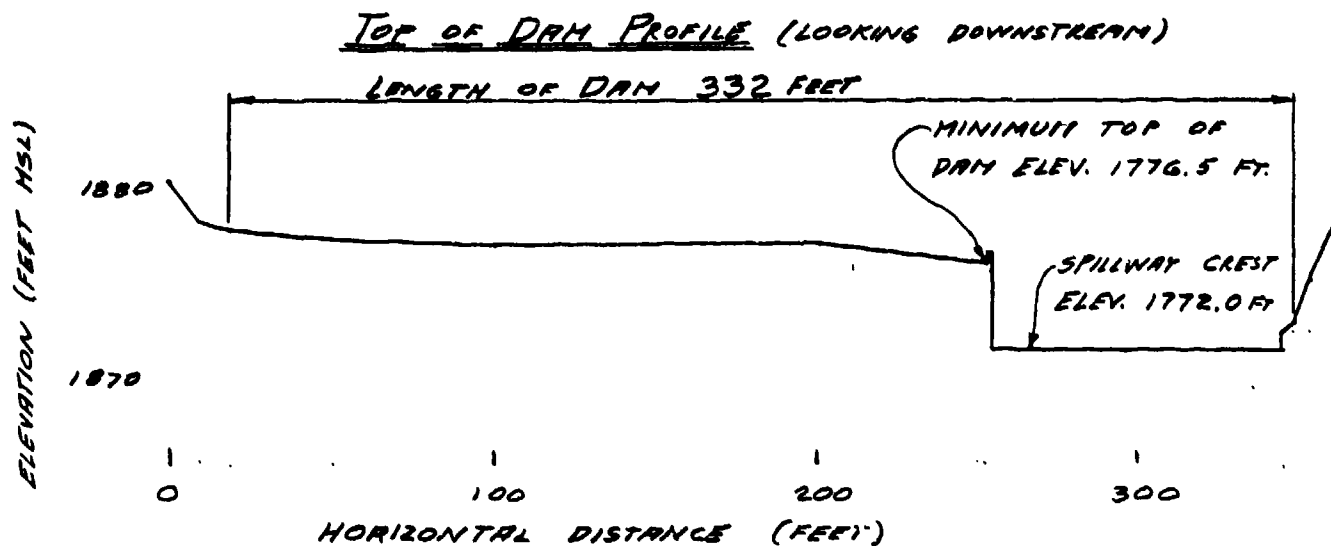


MORRIS RUN MINE DAM NO. 3
DRAINAGE AREA AND CENTROID MAP

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

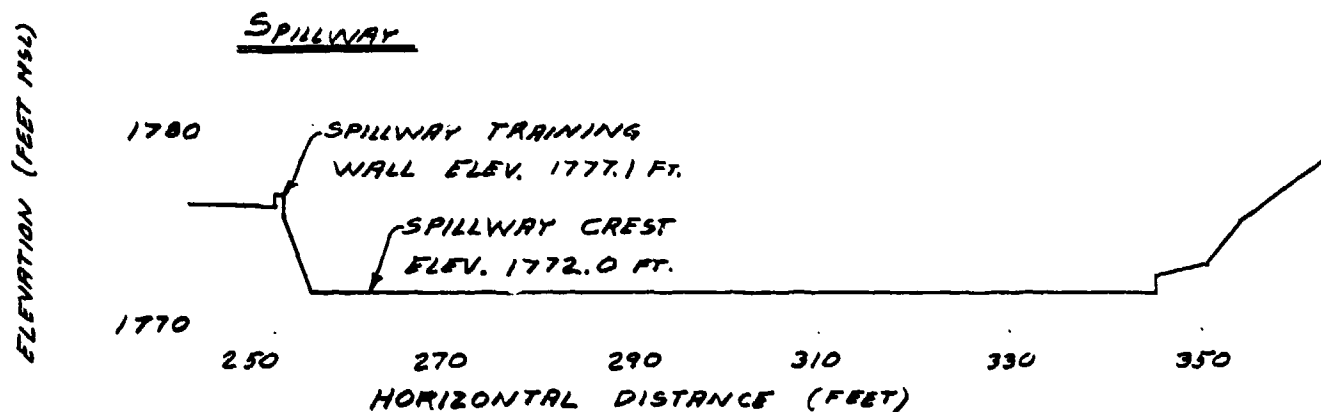
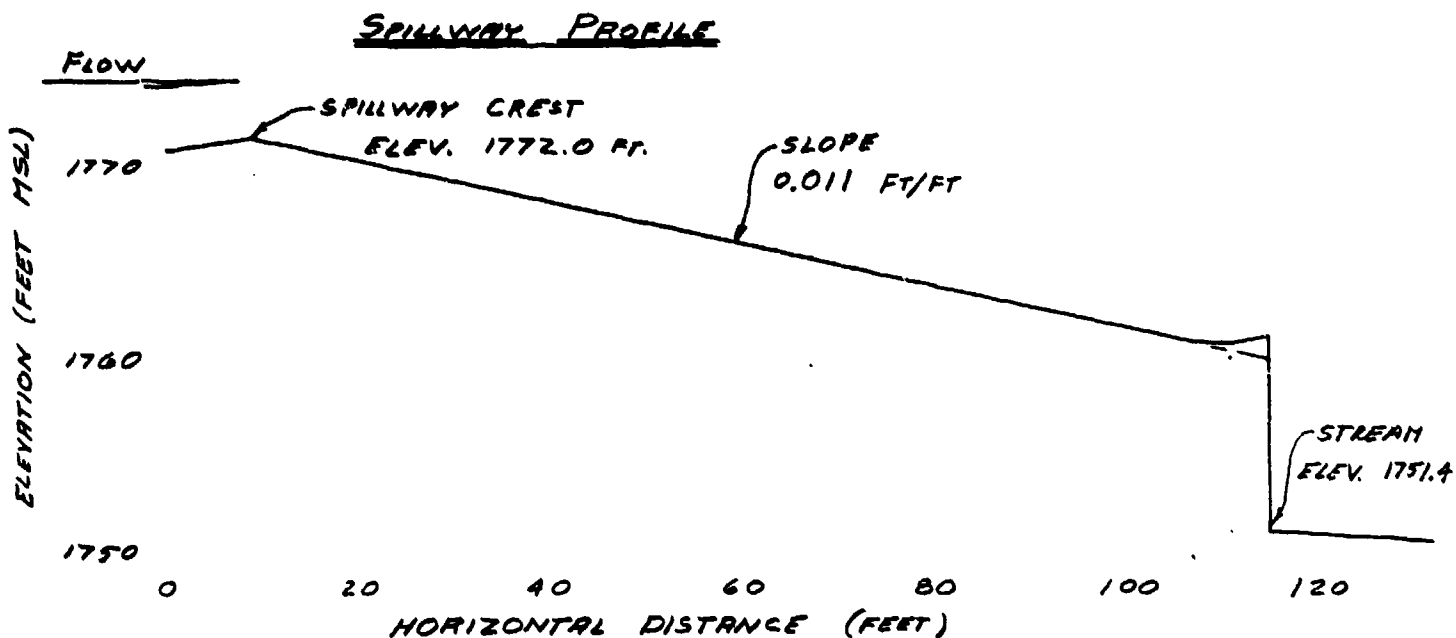
Subject MORRIS RUN MINE DAM No. 3 S.O. No. _____
TOP OF DAM PROFILE AND Sheet No. 3 of 7
TYPICAL CROSS SECTION Drawing No. _____
Computed by GWT Checked by WDV Date 4/1/81



MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject MORRIS RUN MINE DAM No. 3 S.O. No. _____
SPILLWAY DISCHARGE RATING Sheet No. 4 of 7
Drawing No. _____
Computed by GWT Checked by WDL Date 4/1/81



MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

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Beaver, Pa. 15009

Subject MORRIS RUN MINE DAM No. 3 S.O. No. _____
SPILLWAY DISCHARGE RATING Sheet No. 5 of 7
Drawing No. _____
Computed by GWT Checked by WDL Date 4/6/81

SPILLWAY DISCHARGE RATING

DEVELOP RATING CURVE BASED UPON CRITICAL FLOW OVER SPILLWAY

$$V = \sqrt{gD} \quad (\text{CHOW, OPEN CHANNEL HYDRAULICS, P. 43})$$

$$g = 32.2 \text{ FT/SEC}^2$$

$$D = \text{MEAN HYDRAULIC DEPTH} = \frac{\text{FLOW AREA}}{\text{FREE SURFACE TOP WIDTH}} = \frac{A}{T}$$

$$V = \text{MEAN FLOW VELOCITY}$$

$$Q = AV$$

SPILLWAY ELEVATION, (FT)	FLOW DEPTH, (FT)	AREA (FT ²)	TOP WIDTH, (FT)	A/T	V FT/SEC	Q (CFS)	V ² / 2g	RESERVOIR SURFACE, (FT)
1772.0	0	0	88.8	0	0	0	0	1772.0
1772.5	0.5	44.45	89.0	.50	4.01	178.2	.25	1772.75
1773.0	1.0	89.0	89.2	1.00	5.67	504.6	.50	1773.50
1773.5	1.5	134.8	94.0	1.43	6.79	915.3	.72	1774.32
1774.0	2.0	182.1	95.0	1.92	7.86	1,431.3	.96	1774.96
1774.5	2.5	229.8	96.0	2.39	8.77	2,015.3	1.19	1775.69
1775.0	3.0	278.1	97.0	2.87	9.61	2,672.5	1.43	1776.43
1775.5	3.5	326.9	98.5	3.32	10.34	3,380.1	1.66	1777.16
1776.0	4.0	376.4	99.5	3.78	11.03	4,151.7	1.89	1777.89
1776.5	4.5	426.5	101.0	4.22	11.66	4,973.0	2.11	1778.61
1777.0	5.0	477.4	102.5	4.66	12.25	5,848.2	2.33	1779.33
1777.5	5.5	529.1	104.0	5.09	12.80	6,772.5	2.54	1780.04
1778.0	6.0	581.3	105.0	5.54	13.36	7,766.2	2.77	1780.77
1778.5	6.5	634.2	106.5	5.95	13.84	8,777.3	2.97	1781.47
1779.0	7.0	687.8	108.0	6.37	14.32	9,849.3	3.18	1782.18

SPILLWAY CAPACITY AT THE MINIMUM TOP OF DAM
(1776.5 FT) IS 2740 C.F.S.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject MORRIS RUN MINE DAM No. 3 S.O. No. _____
100-YEAR DISCHARGE CALCULATION Sheet No. 6 of 7
Drawing No. _____
Computed by GWT Checked by WDC Date 7/17/81

THE INFLOW TO THE IMPOUNDMENT FOR THE 100 YEAR FLOOD WAS CALCULATED USING MATERIAL FROM "WATER RESOURCES BULLETIN, BULLETIN No. 13, FLOODS IN PENNSYLVANIA", PREPARED BY THE DEPARTMENT OF ENVIRONMENTAL RESOURCES, COMMONWEALTH OF PENNSYLVANIA.

DRAINAGE BASIN FROM PLATE 1 - MODEL 2
REGRESSION EQUATION FROM TABLE 2

$$Q_T = CA^X$$

T = 100 YEARS

C = 564

A = DRAINAGE AREA, 3.41 Sq. Mi.

X = 0.744

$$Q_{100} = 564 (3.41)^{.744}$$

$$Q_{100} = 1405 \text{ C.F.S.}$$

THE INFLOW TO THE IMPOUNDMENT FOR THE 100-YEAR FLOOD WAS CALCULATED USING MATERIAL FROM "THE HYDROLOGIC STUDY - TROPICAL STORM AGNES" PREPARED BY THE SPECIAL STUDIES BRANCH, PLANNING DIVISION, NORTH ATLANTIC DIVISION, CORPS OF ENGINEERS, IN NEW YORK CITY.

DRAINAGE AREA - 3.41 SQ. MI.

- ① COMPUTE THE MEAN LOGARITHM
 $\log(Q_m) = C_m + 0.75 \log A$

$\log(Q_m)$ = MEAN LOGARITHM OF ANNUAL FLOOD PEAKS
 A = DRAINAGE AREA, SQ. MI.

C_m = MAP COEFFICIENTS FOR MEAN LOG OF ANNUAL PEAKS FROM FIG. 21 - 2.14

$$\log(Q_m) = 2.14 + 0.75 (\log 3.41) \\ = 2.5396$$

- ② COMPUTE STANDARD DEVIATION
 $S = C_s - 0.05 (\log A)$

S = STANDARD DEVIATION OF THE LOGARITHMS OF THE ANNUAL PEAKS.

C_s = MAP COEFFICIENT FOR STANDARD DEVIATION FROM FIG. 22 = 0.38

A = DRAINAGE AREA, SQ. MI., = 3.41

$$S = 0.38 - 0.05 (\log 3.41) \\ = 0.3534$$

- ③ SELECT SKEW COEFFICIENT FROM FIG. 23 = 0.32

- ④ $\log(Q_{100}) = \log(Q_m) + K(P, g) S$

$K(P, g)$ = STANDARD DEVIATE FOR A GIVEN EXCEEDENCE FREQUENCY PERCENTAGE (P) AND SKEW COEFFICIENT (g) FROM EXHIBIT 39 OF BEARD'S "STATISTICAL METHODS IN HYDROLOGY"

$$\log(Q_{100}) = 2.5396 + 2.56(0.3534) \\ Q_{100} = 2,780 \text{ CFS}$$

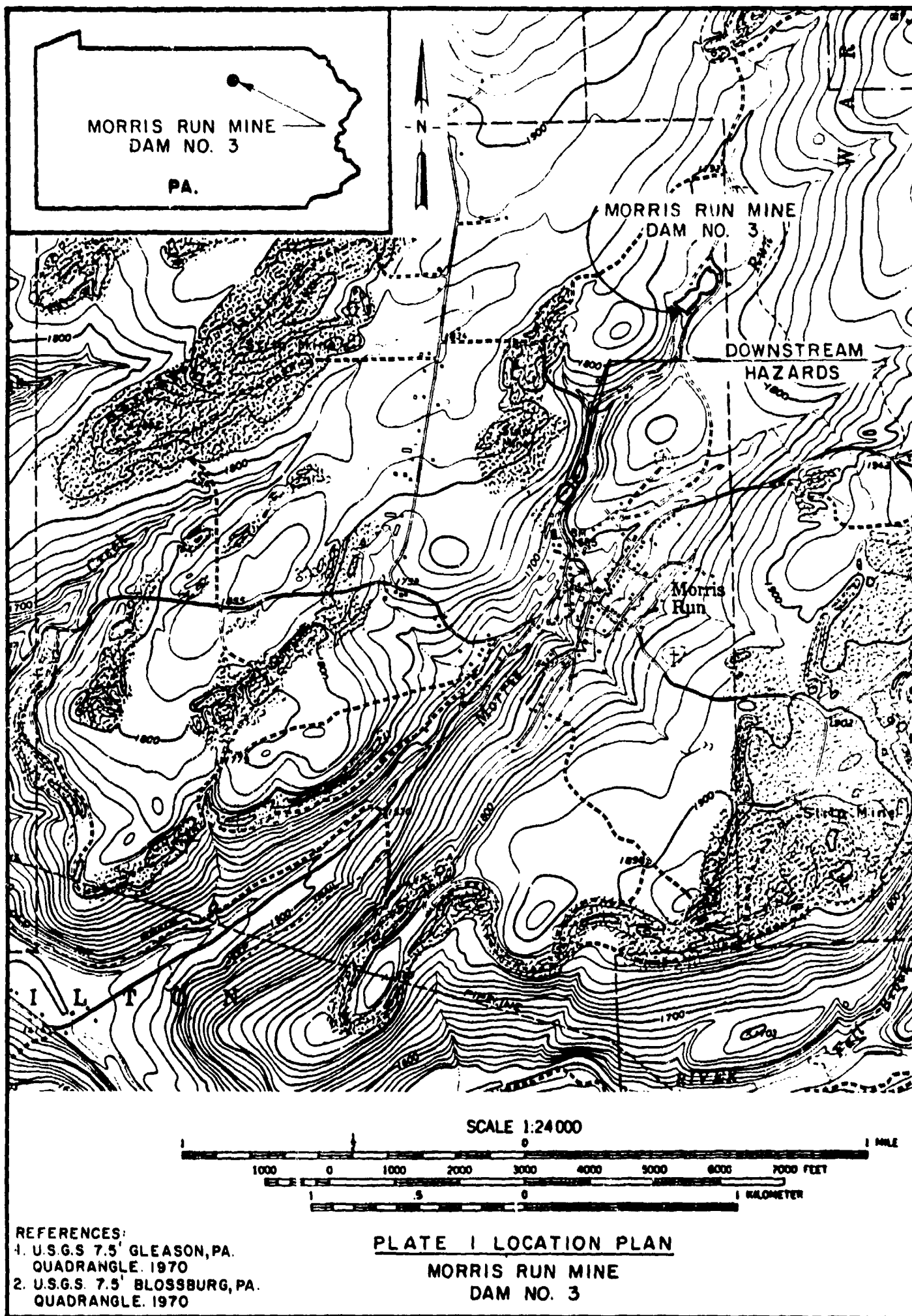
AVERAGING THE INFLOW FROM THIS METHOD AND THE PREVIOUS METHOD GIVES AN INFLOW OF 2092 C.F.S. TO THE IMPOUNDMENT

APPENDIX E

PLATES

CONTENTS

- Plate 1 - Location Map
- Plate 2 - Watershed Map
- Plate 3 - Location Map Drawing
- Plate 4 - General Plan of Dam and Reservoir
- Plate 5 - Plan and Profile
- Plate 6 - Details



MORRIS RUN MINE
DAM NO. 3

PA.

N

APPROXIMATE
WATERSHED AREA

MORRIS RUN MINE
DAM NO. 3

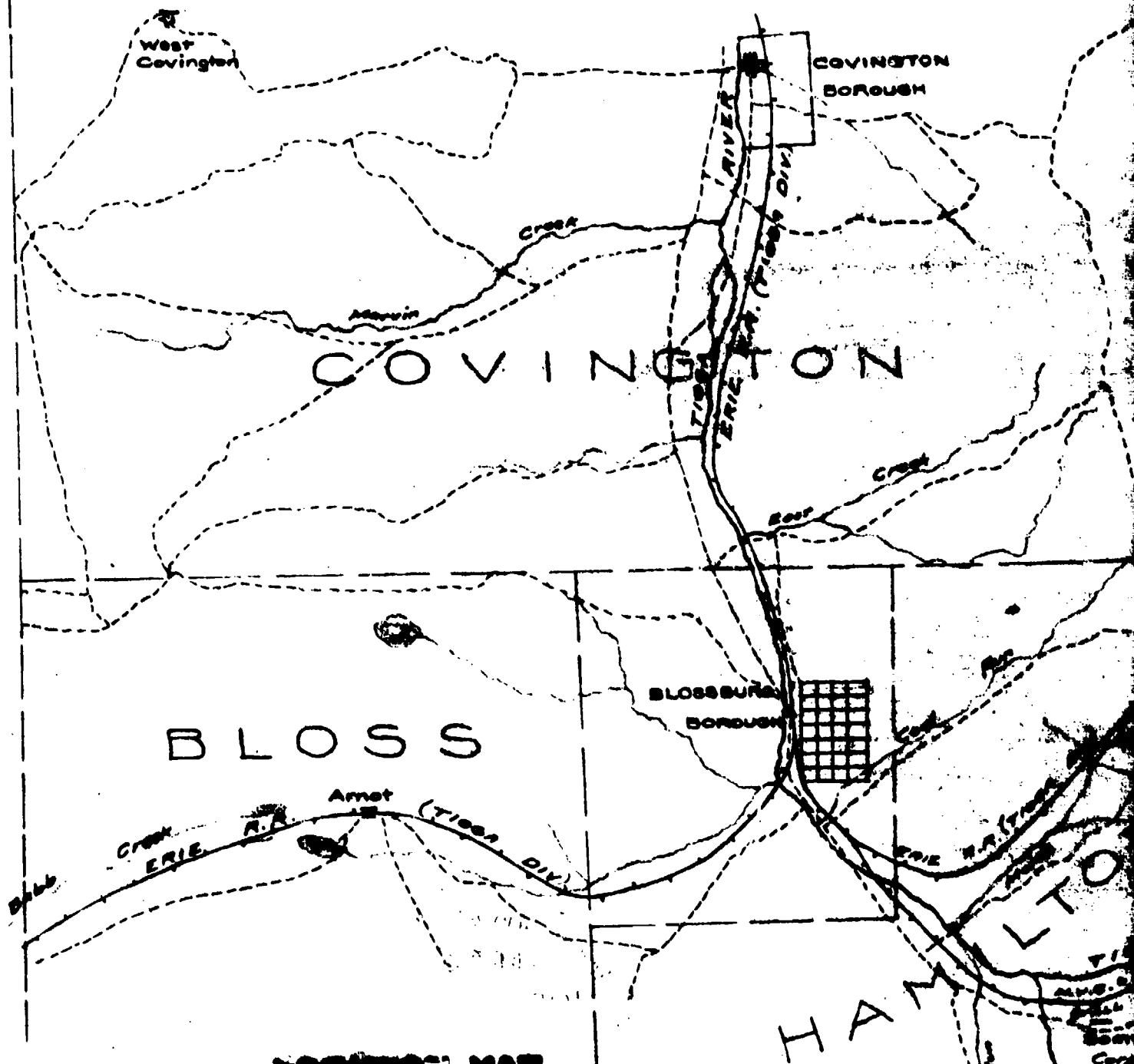
SCALE 1:36,900

PLATE 2 WATERSHED MAP

MORRIS RUN MINE
DAM NO. 3

REFERENCES:

1. U.S.G.S. 7.5' GLEASON, PA.
QUADRANGLE. 1970
2. U.S.G.S. 7.5' BLOSSBURG, PA.
QUADRANGLE. 1970



**LOCATION MAP
OF
PROPOSED RESERVOIR NO. 3
OF THE
MORRIS RUN COAL MINING CO.
AT**

MORRIS RUN, PA.

Scale 1"=1 Mile June 23, 1919

William C. Eng.
Cons. Eng.

SHEET 1

STON
SH

WARD

Proposed
Reservoir
No. 3

Aft

FALL BROOK
BROOK

Howe
Run

STON
TIGER
MOUNTAIN
FALL
BROOK
RIVER

UNION

Somerville
Cemetery

NOTE: MODIFICATIONS HAVE BEEN MADE
TO THE DAM AFTER THESE DESIGN
DRAWINGS WERE COMPLETED.

PLATE 3

12

GENERAL MAP
OF
PROPOSED RESERVOIR NO.3
OF THE
MORRIS RUN COAL MINING CO.
AT
MORRIS RUN, PA.

Scale 1"=50' June 23, 1919
S. H. Hance Cons. Eng.

SHEET 2



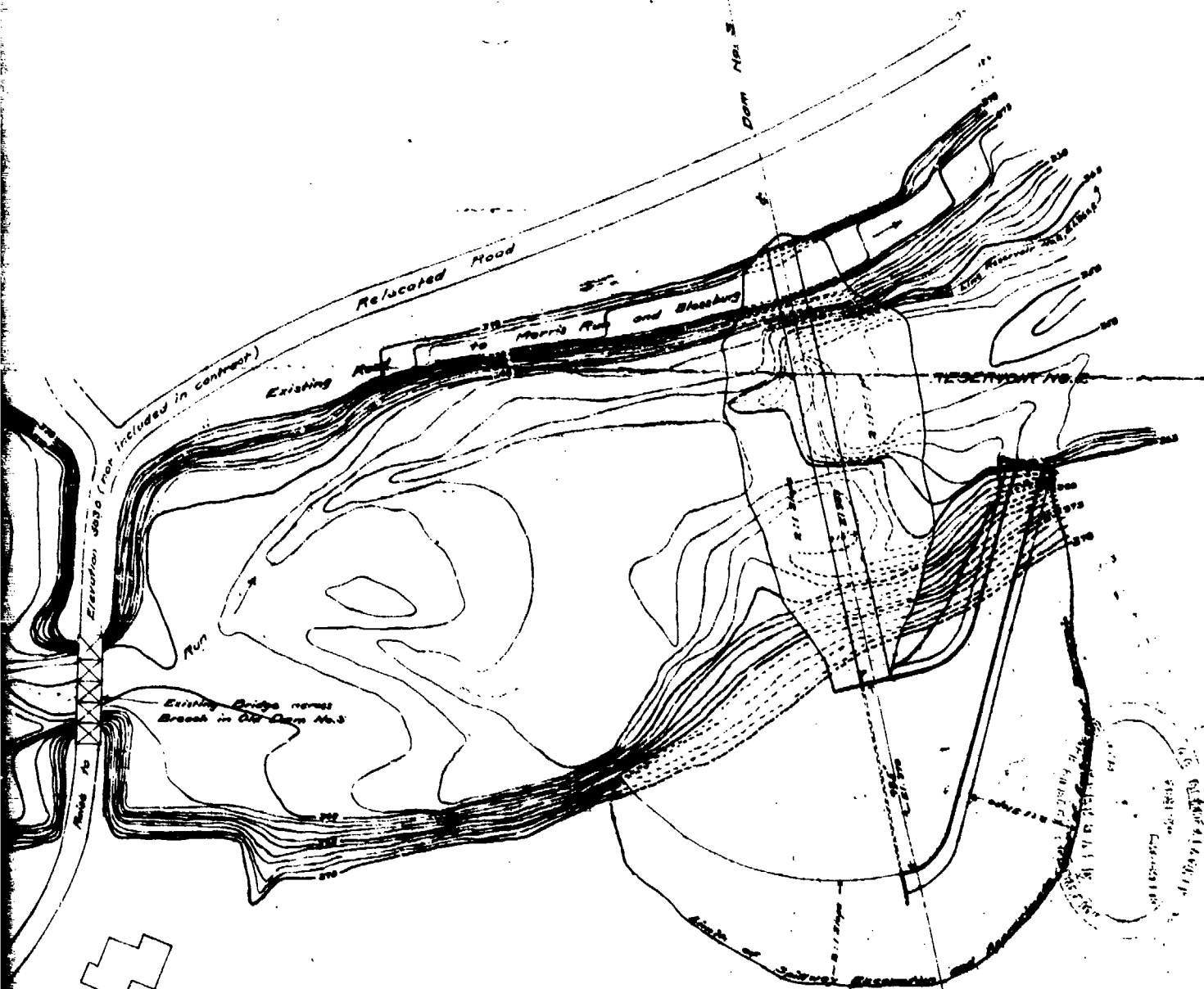
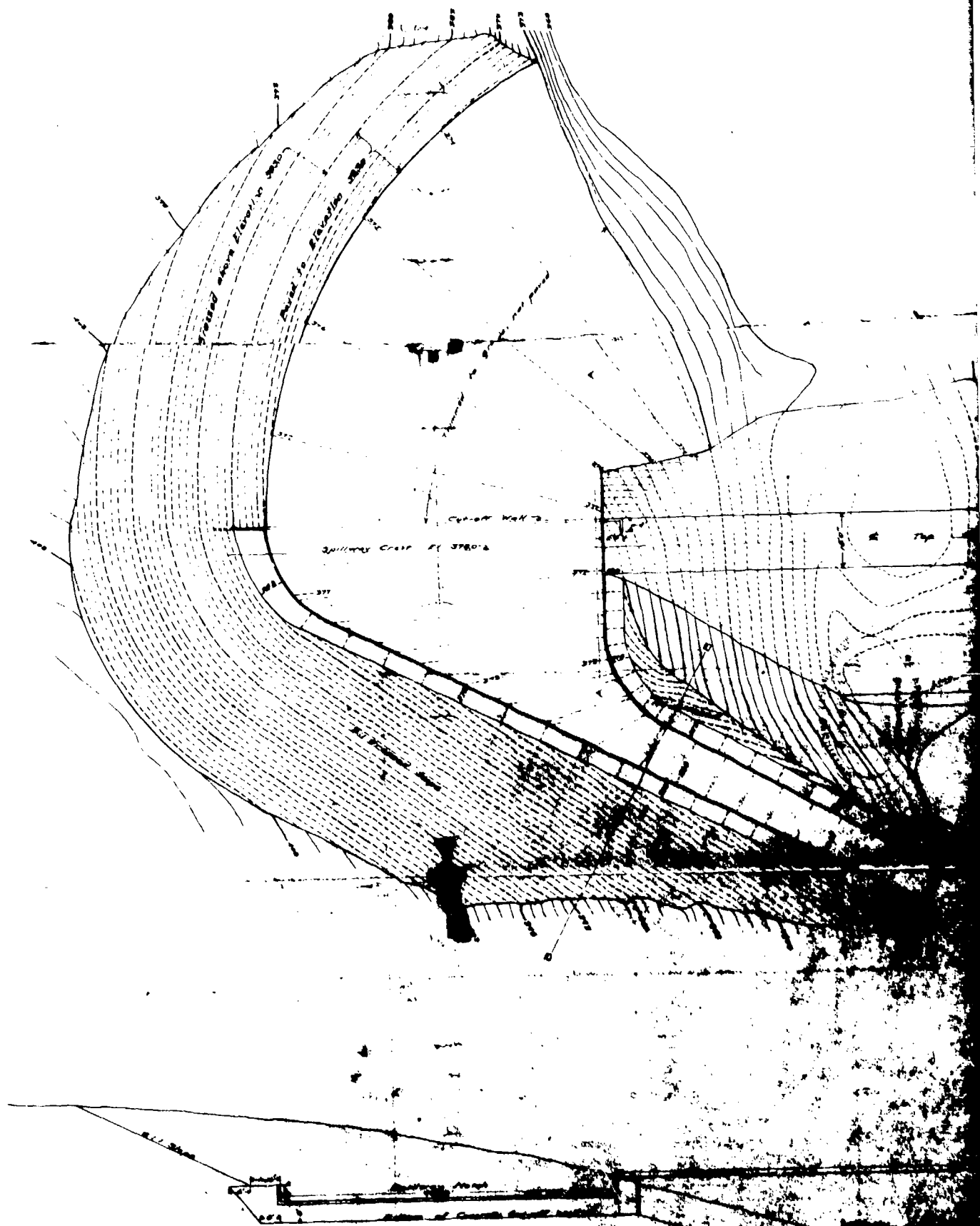
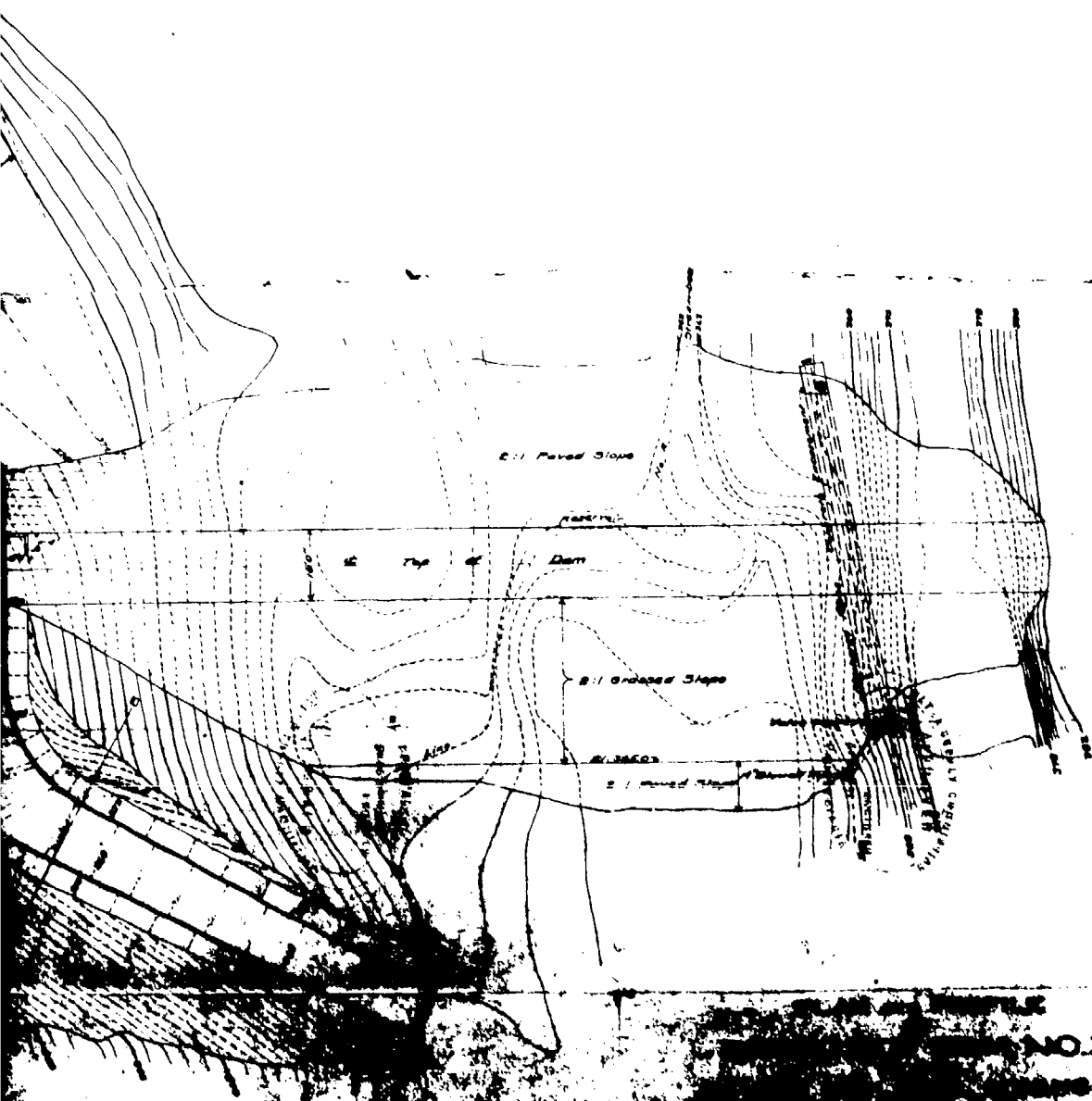
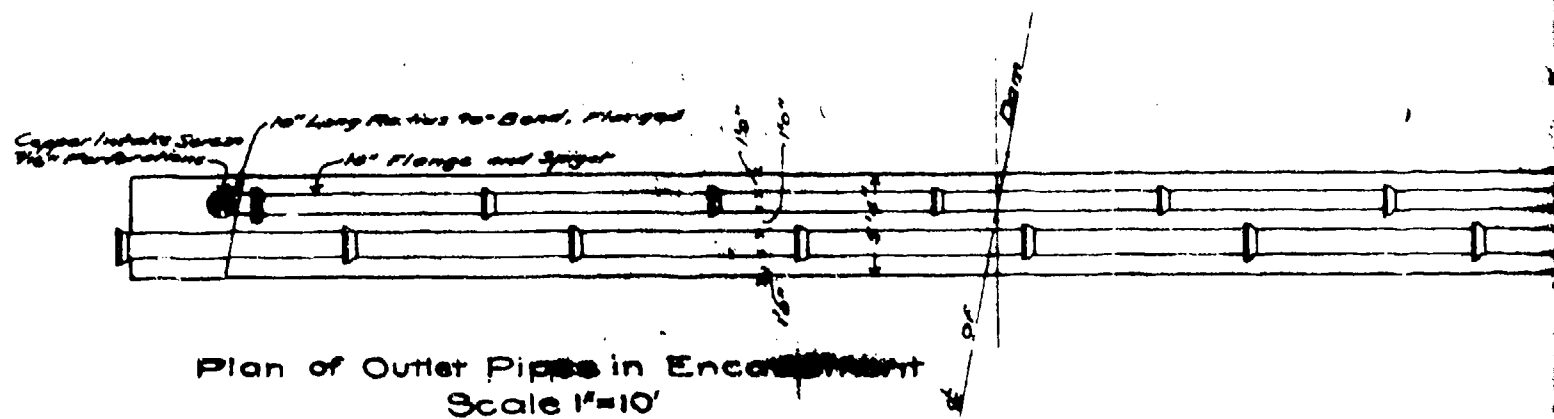
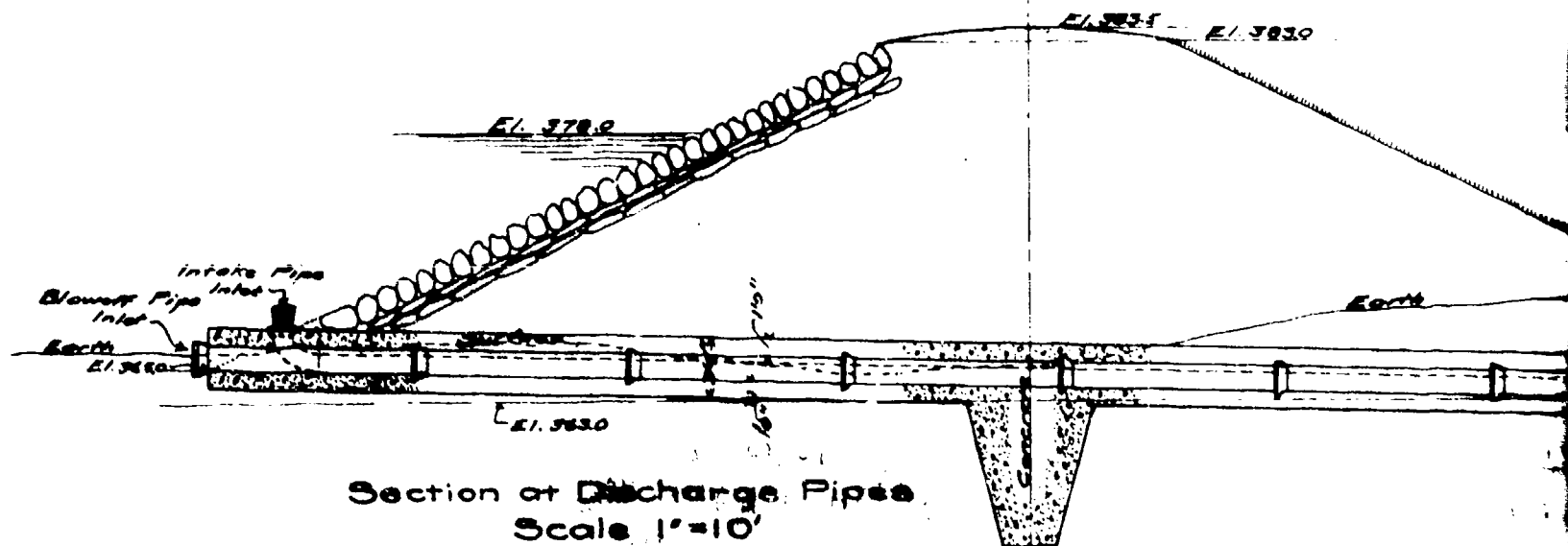
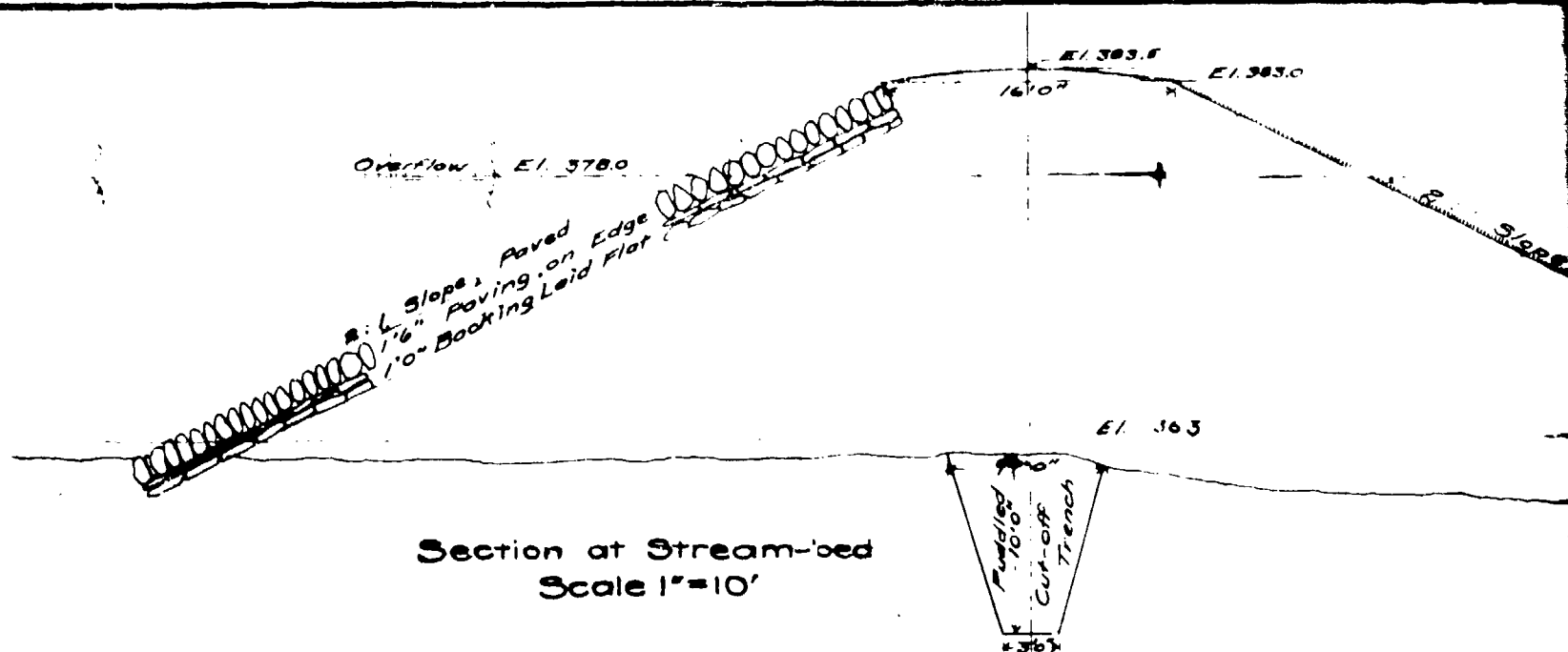
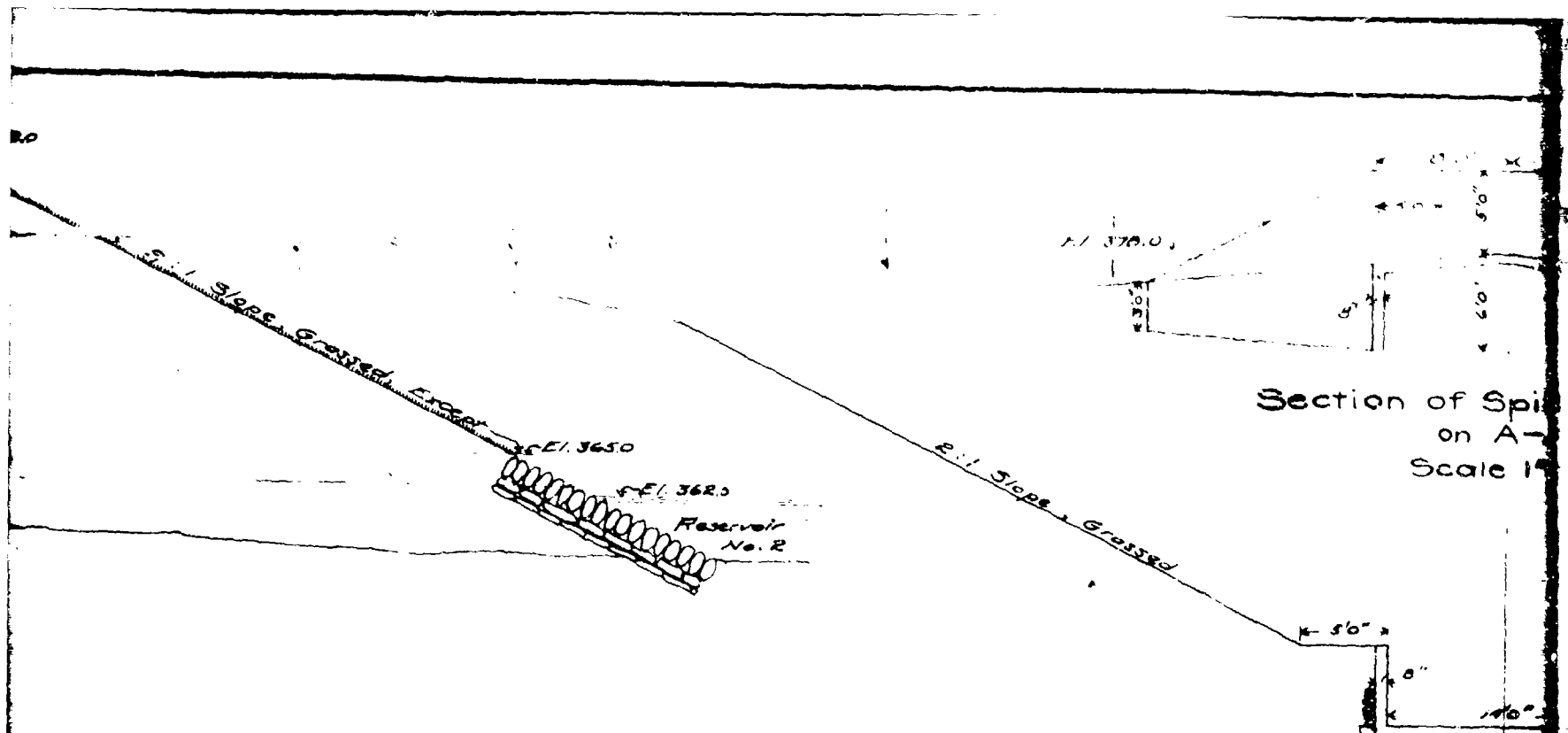


PLATE 4

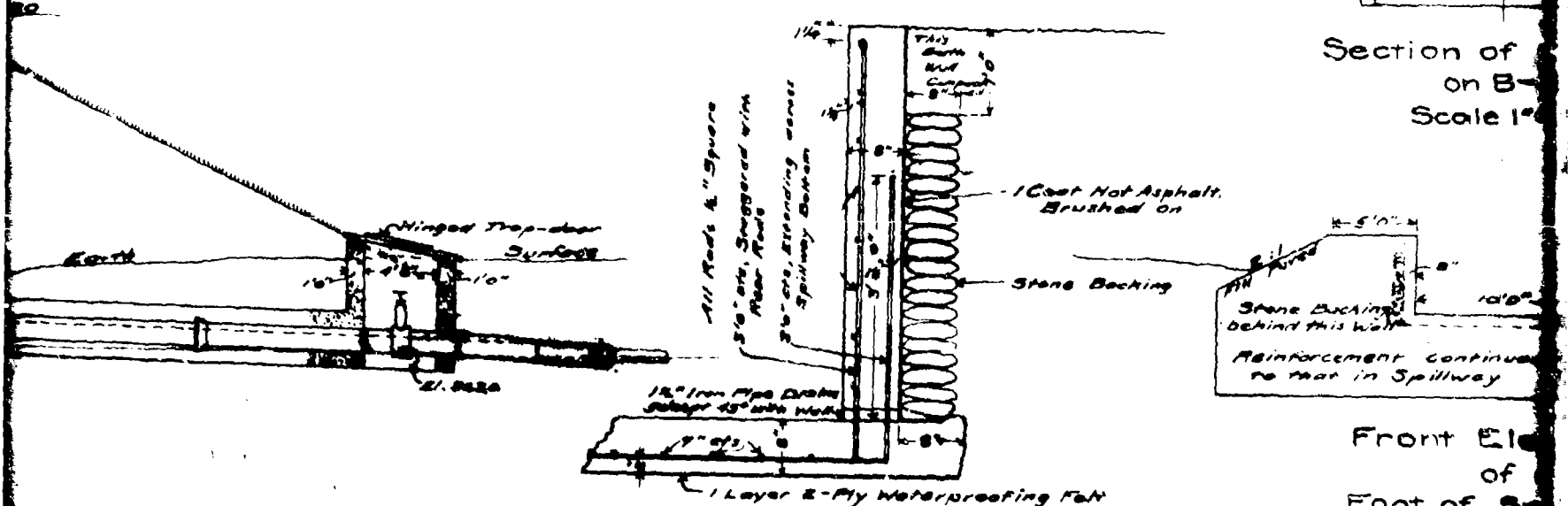




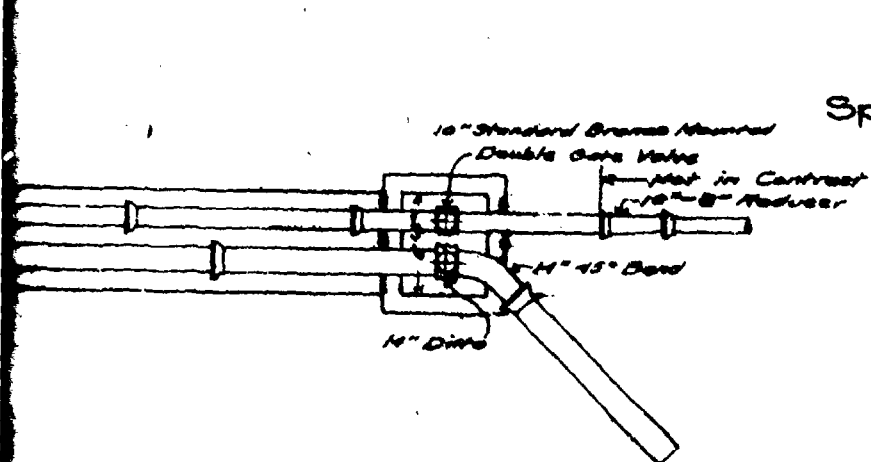




Section of Spillway
on A-
Scale 1" = 2'



Typical Section
showing
Spillway Reinforcement
Scale 1" = 2'

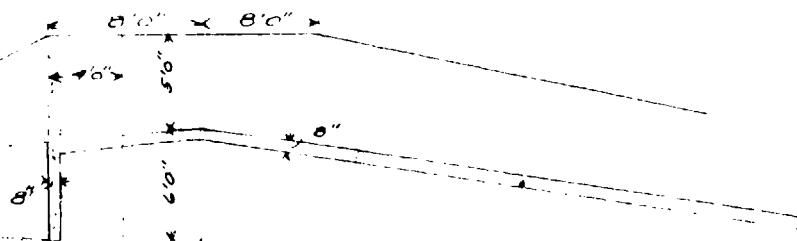


Front Elevation
of
Foot of Spillway
Scale 1" = 2'

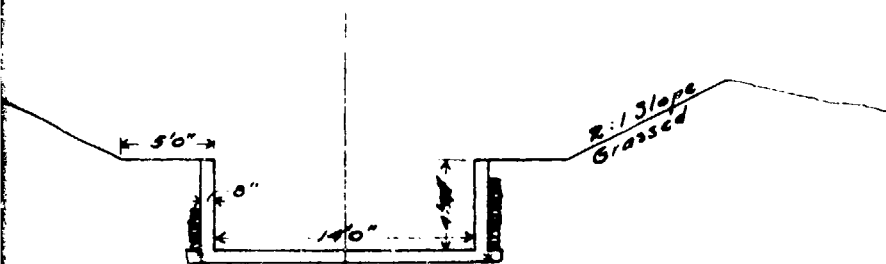
DETAIL
PROPOSED
MORRIS RUN

MORRIS
Scales as shown

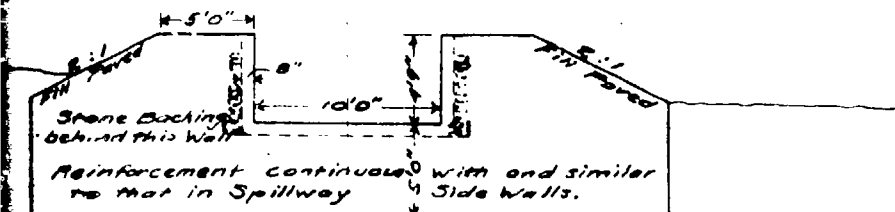
John L. ...



Section of Spillway Notch
on A-A
Scale 1"=10'



Section of Spillway
on B-B
Scale 1"=10'



Front Elevation
of
Foot of Spillway
Scale 1"=10'

DETAIL PLANS
OF
PROPOSED DAM NO.3
OF THE
MORRIS RUN COAL MINING CO.
AT
MORRIS RUN, PA.

Scales as shown June 30, 1919

J. H. Lane Cons. Eng.

SHEET 4 PLATE 6

APPENDIX F
REGIONAL GEOLOGY

Morris Run Mine Dam No. 3
NDI No. PA 01027, PennDER No. 59-8

REGIONAL GEOLOGY

The Morris Run Mine Dam No. 3 is located in the glaciated part of the Appalachian Plateaus physiographic province. The dam sits in the upper reaches of the Morris Run stream valley northeast of the Community of Morris Run. The discharge from the dam flows southwest past the Community of Morris and forms a confluence with the Tioga River. The Tioga River in turn flows north into New York State. The maximum topographic relief from the hilltops to the stream valley is 200 feet. Locally, the topography has been extensively altered by the surface strip mining for coal.

The study area has been glaciated at least three times and is presently overlaid by glacial ground moraine of the Nebraskan, Kansan, and Wisconsin glaciations. No test boring information was available for review; thus, soil types and depths are difficult to ascertain. The Soil Conservation Service Maps indicate that the soil in the vicinity of the dam consist of Erie stony silt loam to the Mandrin very stony silt loam, with slopes that vary from 0-25 percent.

Geologic data taken from the Geologic Map of Pennsylvania indicate that the bedrock in the vicinity of the dam is predominantly composed of sedimentary rocks of the Pottsville Group. These rocks are predominantly sandstones and conglomerates with thin shales, and coals. Regionally, the Pennsylvanian Pottsville Group is underlain by the Mississippian-Pocono Group and the Devonian-Susquehanna Group. In the geologic past the area was subject to regional folding which has resulted in the Pennsylvanian and Mississippian rocks being confined to the higher hilltops.

GEOLOGY MAP LEGEND

PERMIAN



Greene Formation

Cyclic sequences of sandstone, shale, red beds, limestone and coal; base at the top of the Upper Washington Limestone.

PERMIAN AND PENNSYLVANIAN



Washington Formation

Cyclic sequences of sandstone, shale, limestone and coal; some red shale, some micaceous coal; base at the top of the Waynesburg Coal.

PENNSYLVANIAN

APPALACHIAN PLATEAU



Monongahela Formation

Cyclic sequences of sandstone, shale, limestone and coal; limestone prominent in northern outcrop areas; shale and sandstone increase southward; commercial coals present; base at the bottom of the Pittsburgh Coal.



Conemaugh Formation

Cyclic sequences of red and gray shales and siltstones with thin limestones and coals; massive Mahoning Sandstone commonly present at base; Ames Limestone present in middle of sections, Brush Creek Limestone in lower part of section.



Allegheny Group

Cyclic sequences of sandstone, shale, limestone and coal; numerous commercial coals, limestone thicken westward; Vanport Limestone in lower part of section, includes Freeport, Kittanning, and Clarion Formations.



Pottsville Group

Predominantly sandstones and conglomerates with thin shales and coals, some coals micaceous locally.

ANTHRACITE REGION



Post-Pottsville Formations

Brown or gray sandstone and shales with some conglomerate and numerous micaceous coals.



Pottsville Group

Light gray to white, coarse grained sandstones and conglomerates with some micaceous coal; includes Sharp Mountain, Schuylkill, and Tumbling Run Formations.

MISSISSIPPIAN



Mauch Chunk Formation

Red shales with brown to greenish gray flaggy sandstones; includes Greenbrier Limestone in Fayette, Westmoreland, and Somerset counties, Loganoma Limestone at the base in southwestern Pennsylvania.



Pocono Group

Predominantly gray, hard, massive, cross-bedded conglomerate and sandstone with some shale; includes in the Appalachian Plateau Harpoot, Shenando, Cigahopa, Cassaway, Cerry, and Kapp Formations, includes part of "Osage" at Mt. L. Fuller in Polk and Town counties.